Department of Industries, United Provinces

THE OILSEED CRUSHING INDUSTRY

OF THE UNITED PROVINCES

1924-25

BY

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CONTENTS.

Chapter VI.

Chapter VII

Chapter VIII.

Chapter IX.

LIST OF ILLUSTRATIONS.

FOREWORD.

THE WORD OIL AS USED IN THIS BOOK.—The generic expression "oil" is applied to a variety of liquids which are widely distributed in nature, in plants, animals and fishes and which have the common physical property of being fluid either at the ordinary temperature or at temperatures below the boiling point of water. In its ordinary sense in India the word oil at one time only referred to essential oils used for perfumery and to certain other liquid substances insoluble in water which are used for domestic purposes. It did not include substances like *ghee* and grease. But since the introduction of mineral oils the word has acquired a more comprehensive though a more loose sense. This book deals only with a class of fluids which are "composed of compounds of glycerol (glycerin) and fatty acids known to chemical science as glycerides" and which are called fixed or fatty oils. It deals with what in the absence of a better word may be called "vegetable oils" derived chiefly from fruits or seed kernels of certain plants and trees, and does not deal with essential or volatile oils, petroleum or fuel oils, hydro-carbon lubricating oils, resins and oils and fats derived from animals and fishes.

OILSEEDS AND OILS IN THE UNITED PROVINCES.—It has long been recognized that India, which at present is one of the largest of the world's sources of supply of oilseeds, should retain in the country a larger proportion of the seeds now exported. But this is only possible if the oil crushing industry, which is at present conducted by primitive methods, is reorganized on scientific and up-to-date lines. The position of United Provinces as a producer of oilseeds and as a manufacturer of oils is subordinate to that of other major provinces and to the Central Provinces; but her existing wealth in raw materials is considerable and her potential wealth in oils is enormous. Of the seeds which are available for crushing in the province, by far the most important are

rape—*lahee*—and mustard—*sarson*. These being of the hardier kind can thrive in a province of great climatic variations like the United Provinces which accounts for 40 per cent. of the total acreage in India. Rape has long been used as an edible oil in India, and during the war refined oil was used by many European countries in margarine and fat compounds. The foreign and local demand for rape and mustard is almost unlimited. But the quantity of seeds crushed is small, and Rs. 3,36,31,858 worth of rape and mustard out of the total production of Rs. 4,27,85,853 are exported as seeds. The greater portion of cotton seed *binaula* (production Rs. 76,56,000) is retained chiefly as a fodder for milch cows, which is a wasteful procedure. Very little seed is crushed and the cultivator does not understand that cotton cake is a better food for cattle than cotton seed. Sesamum *til* (Rs. 60,63,954) is chiefly grown as a catch crop mixed with other crops. A very small proportion of the produce is exported, and the Indian sesamum is facing severe competition in world markets from Chinese sesamum. But *til* oil, commonly called *meetha tel* is very popular and the internal demand is constant. Linseed—*alsee*—(Rs. 46,49,015): The quantity produced in the province is small, though India is the third most important producing country, and at one time held the dominant position in the world's trade. It is grown largely to meet a foreign demand. Indian linseed has to compete with the linseed of Argentina, and it is doubtful if it can do so successfully in future. It would therefore be safer as it would undoubtedly be more profitable to make oil than to export the raw material. *Mahua* (Rs. 45,00,000): The position of the United Provinces as an exporter of *mahua* seed is negligible though not so as a producer of *mahua* seed and exporter (chiefly to the Punjab) of *mahua* oil. The exports of *mahua* seed from India being on the decline, having declined from 33,000 tons in 1913-14 to 1,000 tons in 1921-22, the only safe policy to adopt is that of concentrating on the production of oil. Castor *raindee* (Rs. 42,00,000): More than one-fifth of the seed produced and imported is exported to Calcutta and other ports. The rest is consumed in the province chiefly

by railways which use it as a lubricant for engines. The value of castor oil exported is Rs. 8,30,466. Large quantities of castor oil were at one time exported from India and the United Provinces and it figures in India's exports as far back as 1804. But owing to the inferior quality of the indigenous oil, more oil seeds than oil have been exported since 1890, except during the war. The demand for the latter in foreign countries is likely to continue owing to the increased use of castor oil for engine lubrication and the internal demand for castor cake for manurial purposes, particularly for sugarcane is likely to grow.

UNSATISFACTORY POSITION OF THE UNITED PROVINCES.—The annual production of oil seeds of all kinds in India is estimated at £50,000,000 or about Rs. 65,00,00,000. The United Provinces produce Rs. 7,07,54,130 worth of oilseeds and import Rs. 5,31,88,013 worth of that commodity. The export trade of the province is 70 per cent. of the total seed grown in the province and of the seed imported, while the exports from the whole of India are generally equivalent in value to only one-third of the total production. These figures are sufficient to bring into lurid relief the backwardness of the oil crushing and refining industry in the province. The unsatisfactory condition of that industry has been engaging the attention of Mr. Duke, and he has shown in this book that oil crushing can be profitably undertaken if carried out with judgement. He has also shown how difficulties and drawbacks can be removed.

QUALIFICATIONS OF MR. DUKE.—Nobody was better qualified than Mr. Duke for conducting a survey of this important industry and for suggesting means for its improvement. He came to the department with 18 years of experience of oil in India and abroad, and for over three years he has been giving theoretical and practical training to oil students at the research and teaching institute at Cawnpore, which he has made the care and joy of his sojourn in India. In this capacity he has displayed an almost infectious enthusiasm for the economic

welfare of the province, and a keen personal solicitude for the welfare of his pupils. He has assisted oil factories with advice, and those which have followed it have increased their output. He has accompanied his pupils to places outside the province to study the methods and conditions of other provinces, and has perambulated all over India in search of employment for his pupils, with the result that the demand for them is at present in excess of the supply. To the investigation into the condition of the oil industry of the province he has brought that zeal, practical knowledge and sympathy by which he has won to victories in other fields of activity. In presenting the results to the public he hazards no prophecies with the breezy recklessness of a dilettante, but the work contains useful practical suggestions based on long experience and intelligent insight.

THE OIL CRUSHING INDUSTRY AND LAND-OWNERS.—The book should arouse special interest amongst large landed proprietors for whose attention and enterprise the oil industry is clamouring. The success of an oil mill depends, amongst other things, upon the command of regular and adequate supply of raw material which is essential for running a factory regularly and economically ; and large land-owners are in the best position to avoid intermittent working of a factory. Then there is the question of utilization of bye-products. For an oil mill to be a commercial success, it is necessary that the resulting oil cakes should be easily marketable at a fair price. Landowners starting oil mills can, with profit to themselves and to their tenants, popularise the use of oilcakes as cattle food and as manure. The gradual exhaustion of Indian soil caused by the export of oilseeds without return of the non-fatty matter to the soil is giving anxious thought to those who concern themselves about India's agricultural future. The Departments of Agriculture have time after time drawn attention to the seriousness of the peril to which Indian agriculture is being exposed and in 1919 the Board of Agriculture recommended the imposition of an import duty on the export of oilseeds

and oilcakes. They said "Oilseeds contain a large percentage of nitrogen, which is the most valuable of all manure constituents and is absolutely necessary to maintain the fertility of the soil. No other constituents can take its place, and it is acknowledged that when applied with organic matter such as oilcakes it is more valuable than any other form." As intensive cultivation comes into practice and results in the adoption of seeds with higher yield, the question of developing the manurial resources will have to be taken up seriously. It will always be difficult in a conservative province like ours to introduce new manures, and all efforts will have to be directed towards preventing the depletion of existing supplies. Some difficulty will have to be faced in encouraging the use of oilcakes as a feeding stuff and manure. The Indian cultivator is at present *unable* to pay a price equal to what the manufacturer of cakes can get by exporting them. But a land-owner running an oil mill on his estates will be able to sell cakes to his cultivators on easy terms. He will incur no freightage and he can safely sell cakes on short term credit.

PROSPECTS OF OIL CRUSHING.—Lastly, the erection of oil mills by land-owners will give to tracts which are predominantly agricultural a bias towards manufacturing processes; and this is consideration of no small importance in connexion with the fundamental factors in the industrial situation of the country. If we are to relieve the pressure on the soil without causing disintegration of rural life, and if we are to have industries that will last, they must be such as draw their men and material from the soil, are situated in rural but accessible tracts, and can find a domestic market for part of their product. Now, of all the manufacturing industries of the country none presents greater scope in the United Provinces and promises better results at the present time than oil crushing and oil refining.

WAJID HUSAIN,
Director of Industries, United Provinces.

INTRODUCTION.

THERE are a large number of people to whom the vegetable oil industry is an entirely unknown subject, and, in view of statements which may from time to time be heard emanating from persons who should know better, it may be desirable to define the scope of the industry, mentioning the different branches of it, the articles made, and their uses. The industry as it is in the provinces at present can only be considered as being in the very early stages of development, and but a few of the articles enumerated are manufactured in the provinces. For this reason every effort should be made to develop an industry which can find employment for a very large number of persons, and, if developed upon sound lines, can add much to the position and wealth of the province.

In the following pages there is a note upon the plant in use in oil mills of the province and methods of working, also suggestions for improved methods. This has been written with a view of assisting the owners of mills in putting their plant in better condition, to assist them to increase their output and profits with a minimum expenditure, and to help them in the choice of new machinery.

It is to be hoped that oil mill proprietors who happen to read this note may be ready to appreciate that there are more ways than one of working an oil mill, and that if highly trained men are employed in the industry, their knowledge will more than recoup the firm for whom they work, for any increased wages which they may command.

To the uninitiated it may appear that there is no particular art in oil milling, to those that have only recently entered the business it appears that there is more to be learned than they had anticipated, and to those who have spent the best part of their lives in the industry it appears that each day there is something new to learn.

Since the industry in the United Provinces can only be considered even now in its early infancy, the methods in use being of the crudest, there is much to be learned in the province before the industry can attain the high standards existing in Europe and America.

Already much has been done to improve the class of seed used in the province for the production of larger crops, and to improve the quality in the direction of disease resisting powers, but much still remains to be done in the matter of growing that class of seed which, while having these necessary qualities, may also possess the highest possible quality in respect of oil yield.

An average improvement of one per cent. in the oil content of the oilseeds grown in the province would represent an increased value of at least Rs. 15,00,000 per annum.

A glance through the following pages will show that there is much to be done in the province in improving seed, oil mills and methods of working them, that there is ample scope for intelligence, which will in due course bring its reward.

In the preparation of this booklet I have had considerable assistance from Mr. M. N. Bose, M.A., who carried out the work of making analyses of oilseeds from this province and other places. Much of the work was of a particularly tedious nature extending over many months, and my thanks are due to him for the way he carried out this work. I have also to acknowledge the work of Mr. J. S. Vatal, Superintendent of Industries, Allahabad division, who undertook the work of translating the publication into Urdu, thereby enabling the book to be read by a very much greater number of persons interested in this industry.

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CAWNPORE.
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The Oilseed Crushing Industry of the United Provinces, 1924-25.

CHAPTER I.

THE VEGETABLE OIL INDUSTRY AS IT IS IN THE PROVINCE AND WHAT IT MIGHT BE.

The following is a list of articles at present being made from oil-seeds in the province :—

Crude oils	....	Mahua oil	Mahua cake.
		Mustard oil	Mustard cake.
		Linseed oil	Linseed cake.
		Til oil	Tilseed cake.
		Castor oil	Castor cake.
		Poppy oil	Poppy cake.
		Neem oil	Neem cake.

These oils are consumed in a more or less crude state, and no great variety of products are made from them in the province, with the exception of soap from mahua oil, boiled oil from linseed oil and batching oil from mahua oil.

The following list comprises a number of articles which are made from similar oils in other countries :—

		Article.		Uses
Mahua oil	....	Butter substitutes	....	Confectioners and bakers.
		Lard ,,	....	Ditto.
		Chocolate fats	....	Confectioners.
		Soap	....	Household and textile.
		Candles	....	Household.
		Glycerine	....	Domestic and manufacturing purposes.

	Articles.	Uses.
Mustard oil ...	Refined edible oils....	Food.
	Lubricating oils (blended).	Motor cars.
	Liniments	Medicinal.
	Soap.	
	Glycerine.	

The steel industry uses this oil in large quantities.

Linseed oil	Edible fats	Biscuit making.
	Boiled oils	Paints and varnishes.
	Oil cloth.	
	Linoleum.	
	Tarpaulins.	
	Vulcanised oils.	
	Patent leather.	
	Soap.	
	Glycerine.	
	Leather substitutes.	
	Hydrogenated oil.	
Til or sesame oil (refined and deodorised).	Margarine	Edible purposes.
	Salad oil	Ditto.
	Hair oil	Domestic.
	Cooking oil	Ditto.
	Soap and glycerine.	
	Hydrogenated oil.	
Castor oil	Medicinal oil.	
	Lubricating oils (blended).	Motor cars, aeroplanes.
	Turkey red oils	Textile dyeing and leather trades.
	Soap.	
	Vulcanised oils.	
	Rubber substitutes.	
	Glycerine.	

	Article.	Uses.
Poppy oil	Edible oils	.... Domestic purposes.
	Salad oils	.... Ditto.
	Artist paints.	
	Soap.	
	Glycerine.	
	Tooth pastes.	
Neem oil	An article suitable for medicinal soap making; is at present used medicinally as a liniment.	

Although there may not be the demand on a large enough scale to warrant the erection of big factories such as exist in Europe and America, there is certainly sufficient demand at present to keep a number of small establishments busily engaged, in producing some of there articles.

During the last fifty years the world demand for vegetable oils and fats has grown to gigantic proportions. This has come about through the scarcity of sufficient animal fats, to the growing demand for edible oils, soaps and lubricating oils, and to the increased demand from the textile trades. That the demand in India will tend to increase rather than decrease may be judged by what has occurred in other countries, namely, that as the wealth and standard of living has increased, the consumption of oils has risen accordingly. As India develops her manufacturing industries, the demand for oil of all kinds will certainly increase far beyond present proportions, and it is quite possible that before many years India may be importing oilseeds instead of exporting them.

Taking the industry as a whole it appears to be in a reasonably prosperous condition, but at the same time it might be in an infinitely more prosperous state were a little more attention given to economies of the right kind.

There has recently been considerable expansion in the trade, but it does not appear likely that there can be any over-production for a very long time ahead.

There have unfortunately been incidents which have tended to give the industry a serious set-back, not only in this province but in other parts of India. This set-back may be attributed to two primary causes, namely, individuals and limited companies commencing business on an extravagant scale, erecting huge plant in different parts of the country, with little or no technical advice and with no certainty of being able to market their products, the concerns have usually been saddled with too much capital, and too much of this capital has been expended in things which are non-productive; on the other hand there have been people who have commenced their business with too little capital and who have very soon seen their mistake.

The business is one which gives a reasonably good profit; it requires a considerable amount of capital, and it is necessary to spend the capital with the utmost caution; the business cannot otherwise be established on sound economic lines, and will not stand extravagance.

In order that the export trade may be developed it would first be necessary to get freights for oil and oilcake more in line with existing rates for oilseeds; this applies not only for railway, but also for steamer freights.

The amount of seed grown in the province is sufficient to supply any possible extension in the seed crushing industry in the near future.

CHAPTER II.

The annual seed harvest is at present considerably greater than the amount of seed crushed in the province, without taking into account the cotton seed crop which amounts to 3,628,000 maunds.

The following table shows the seed harvested in the province in an average year :—

Kind of seed.	Weight Mds.	Value. Rs.
Rape and mustard	6,582,439	4,27,85,853
Cotton seed	3,828,000	76,56,000
Til	1,010,659	60,63,954
Linseed	664,145	46,49,015
Mahua	500,000	45,00,000
Castor	600,000	42,00,000
Ground-nuts	69,140	3,45,700
Others	92,268	5,53,608
Total	13,346,651	7,07,54,130

There are exported annually the following seeds from the province :—

Kind of seed.	Weight. Mds.	Value. Rs.
Rape and mustard	5,174,132	3,36,31,858
Linseed	1,934,818	1,35,43,726
Cotton seed	1,392,200	27,84,400
Poppy seed	287,056	25,83,504
Til or gingelli	258,318	15,49,908
Castor seed	117,585	8,23,095
Others	452,537	2,71,522
Total	9,616,646	5,51,88,013

Import of oilseeds to the United Provinces from other provinces :—

Kind of seed.	Weight.	Value
	Mds.	Rs.
Castor seed	88,444	6,19,108
Rape and mustard	82,081	5,33,526
Til or gingelli	78,492	4,70,952
Ground-nuts	47,632	2,85,792
Cotton seed	58,477	1,16,954
Linseed	10,471	94,239
Others	50,893	3,05,358
Total	4,16,490	24,25,929

The export trade in oilseeds from the province amounts, as shown in the above table, to 9,616,646 maunds ; this goes chiefly to the following places :—

Calcutta.	Rajputana.
Bombay.	Central India.
Karachi.	Hyderabad State.
Punjab.	Mysore.
Bihar.	

From the foregoing tables it may be seen that the export trade in oilseeds at present is almost 70 per cent. of the total seed grown in the province *plus* those imported.

There is, however, plenty of seed available for present demands, but it would be better for the province were it possible to crush the whole of the seed available and make exports in oil and cake, thereby giving industrial employment to the people and adding to the wealth of the province.

With the exception of 35,539 maunds, the whole of the cotton seed exported goes to the Punjab where it is used as seed ; large quantities are also fed to cattle in the form of seed, while there appears to be no crushing of cotton seed in the Punjab or in these provinces. This

industry will undoubtedly be established in the province at some future date, but the factors which prevent its being commenced are, firstly, there is no market locally for cotton seed cake, and other bye-products, such as exist in Europe and America, the Indian agriculturists preferring to feed their cattle on seed in preference to cake; secondly, the low percentage of oil contained in Indian cotton seed does not attract the oil millers of the province or elsewhere, since other classes of cotton seed contain 2 to 3 per cent. more oil. The agriculturist requires educating up to the fact that cotton seed cake is a better food for cattle than cotton seed; and when this is done there will spring up a new and profitable branch of the oilseed crushing industry of the province, which will employ a large number of skilled and ordinary labourers, and the whole of the cotton seed of the province will be crushed in the province and not exported as is the case at present.

It is probable that the seed harvested each year considerably exceeds the figures given, since there is much seed grown as a mixed crop, particularly mustard and linseed.

CHAPTER III.

In the United Provinces there are established some 69 oil mills, all of which are in constant work. The size and capacity varies very considerably.

These 69 mills together contain the following plant :—

Power driven or hand driven screw presses	....	86
Power driven ghannis or kolhus	....	1,358
Anderson expellors and Smulders expellors	....	3
Anglo-American hydraulic presses	....	26

The amount of seed crushed annually by these 69 establishments amounts to 1,908,572 maunds.

Distributed throughout the province are a large number of small—*telis*—who own their own small ghanni mill which is usually driven by bullock power; these people keep their mill running only three or four months of the year; between them they crush annually some 780,600 maunds from probably 3,000 ghannis (exact figures not being available) and employ some 6,000 persons. Exact figures are not available in connexion with these small—*telis*,—therefore these figures must be accepted as estimates only.

The number of persons employed in the 69 oil mills is on an average 1,806 throughout the year.

The plant in these mills is for the most part old and in bad condition, the hydraulic presses being from 10 to 50 years of age.

This is one great fault, since with plant of such ancient type not made sufficiently strong to give the high pressures, of which modern presses are capable, results in much of the oil being left in the cake, with a corresponding decrease in profit.

Steam engines can frequently be found at work which date back 30 years; these have been purchased cheaply as second-hand plant, and are usually most extravagant in steam consumption. Of the whole number of mills there are only one or two that have plant which can be considered approaching the machinery of the present day.

CHAPTER IV.

The total value of the oil and oilcake produced in the province as far as can be ascertained is :—

	Rs.
Oil	1,60,00,145
Cake	52,43,745
Total	2,12,43,890

This represents the crushing of some 2,689,172 maunds of seed.

The imports of oil from places outside the province are as under :—

	Weight. Mds.	Value. Rs.
Rape and mustard oil	14,143	2,34,395
Coconut oil	10,178	2,69,717
Castor oil	13,586	3,53,236
Other oils	75,183	11,57,256
Total	113,090	20,14,568

The exports of oil from the United Provinces to places outside are :—

	Weight. Mds.	Value Rs.
Rape and mustard	121,258	19,40,128
Castor oil	31,941	8,30,466
Other oils	147,840	20,69,760
Total	301,039	48,40,354

This oil is chiefly consigned to the Punjab, Rajputana, Bengal, Calcutta and Bihar.

The imports of oilcake from places outside the provinces amount to 207,471 maunds, value Rs. 7,26,148 per annum.

The greater part of this goes to the Punjab annually about 2,63,596 maunds, while Bombay, Bengal, Bihar and Orissa, Calcutta, Rajputana and Karachi are also large buyers of oilcake from these provinces.

It is a great misfortune to India that the agriculturist has so far not been educated up, so that he recognises the value of oilcake as a feeding stuff for his cattle and as a fertiliser for his crops. When this has been achieved it will make a vast difference to the country, and will doubtless increase the profit of both agriculturist and oil miller.

The trade in oil which has been produced in the province is on the increase.

The largest proportion of the oil produced is mustard oil, used almost entirely for edible purposes, not only in the province but in the places to which the oil is exported.

In normal years the trade in mahua oil must reach figures approaching 150,000 maunds; this crop has been very popular amongst oil seed crushers during recent years, it is comparatively easy to crush and the yields of oil obtained by local mills varies from 36 to 40 per cent.; this oil is almost exclusively used for soap making, for which purpose the Punjab are large buyers.

The largest buyers of castor oil in the province are undoubtedly the railways, some of which have their own oil mills, so as to insure of being able to obtain the quantity and quality of oil that they require. Most of the castor oil made in the province is of very poor quality, being too acid, and the colour is too dark to enable the best prices to be obtained.

More attention should be given to the storage of seed in dry godowns, since, if the seed becomes wet, the oil rapidly become acid.

This also applies to the crop of mahua seed which, being collected in the rainy season, is apt to be insufficiently dried before storage; it is not uncommon to find mahua oil from seeds of this province containing as much as 20 to 25 per cent. of free fatty acid.

As much of this oil is consumed in the manufacture of cold process soaps, the soap manufacturer often has difficulties caused directly by this fact.

The seeds when collected should be laid out in the sun to dry and occasionally turned over to remove moisture as much as possible and to prevent the seed getting heated; practically all samples of seed examined are mouldy, and much is blackened by over-heating, due to being bagged up in a damp condition.

The import of coconut oil is due to a demand chiefly for purposes of soap making, there being no oil in the province quite equal to it for this particular purpose. It produces a good coloured soap, lathers well and holds moisture rather better than other oils.

There is a good demand for oilcake both for local consumption and for export, the Punjab being usually the best customer which this province has for oilcake.

There is always a difficulty in finding a market for mahua cake, since it has a low value as manure and is not suitable for cattle food.

Formerly a considerable quantity was shipped to Japan, but this market has not been buying recently; the bulk of the mahua cake is now used as fuel mixed with coal by the oil mills producing it, and during the coal shortage other buyers were found for it at twelve annas per maund as fuel.

There appears to be plenty of scope for the establishments in the province of paint and varnishes works, since large quantities of these articles are imported to India and the United Provinces.

During the course of a year India imports from Europe paints, colours, and varnishes to the value of Rs. 14,00,000.

In addition there is imported linseed oil to the extent of 31,418 maunds, this is almost entirely boiled linseed oil for use in the paint trade; probably a good portion of this oil is manufactured from Indian seed, from which the oil was extracted in Europe, converted into boiled oil and returned to India.

There are certainly good openings in this country for the establishing of mills where linseed is pressed and boiled oil, paints and vanishes manufactured, but it is useless to attempt to establish such industries unless they are run by persons with complete knowledge of the trade.

There are approximately 187,000 square yards of oilcloth imported annually; there is no factory of the kind in the province; there has, however, been recently established a mill for the manufacture of this article in Bombay.

Candle manufacture does not exist in this province; there was a factory producing a good class of candle in Baroda, where also textile and other soaps are manufactured, but this has been closed owing to disagreement between the partners.

The imports of candles to India from Europe is about 234,986 lbs. per year.

Glycerine is not manufactured in the province, the requirements being imported; this industry could be taken up in conjunction with the manufacture of soaps and candles, if undertaken upon a sufficiently large scale.

CHAPTER V.

The bulk of the seed crushing industry is carried on in the following places by the 69 oil mills already mentioned; against each is placed the number of existing mills and the weight of seed crushed :—

Places.	Number of oil mills.	Maunds of seed crushed per annum.
Cawnpore	10	1,021,950
Agra	5	404,900
Allahabad	34	261,072
Gorakhpur	5	67,250
Banda	1	50,000
Moradabad	1	43,150
Bahraich	2	40,000
Lucknow	2	12,600
Ballia	7	5,000
Fatehpur	2	2,650
		1,908,572

The chief districts in which seed is crushed by small *telis* are enumerated below :—

District.	Weight of seed.
	Mds.
Mirzapur	188,774
Benares	176,256
Jhansi	156,930
Hamirpur	128,525
Banda	75,000
Etah	47,199
Meerut	8,000
	780,684

CHAPTER VI.

NOTE UPON THE OIL MILLS OF THE PROVINCE, THE PLANT IN USE AND METHODS OF WORKING, WITH PRACTICAL SUGGESTIONS FOR IMPROVEMENTS.

It is distinctly a misfortune that but few of the capitalists engaged in oilseed crushing have had the benefit of technical training, as mechanical engineers or chemists.

The bulk of them are purely of the merchant class, and as such do not take the same keen interest in maintaining their machinery in a high state of efficiency, as would otherwise have been the case.

There appears to be a general inclination to grudge any outlay on plant until the moment arrives that a machine is actually broken, and becomes unworkable.

This attitude can only be attributed to a want of knowledge, which a trained engineer would have, and which in the course of a year's work would save endless loss of time and money.

It must be said that although the majority of the mills are run profitably, they are not run on what would be termed strict economic lines. Undoubtedly the matter of actually making purchases of seed, and the sale of oil and cake are as well carried out as in any other part of the world, but there is a marked difference when the case of manufacturing comes to be considered.

PURCHASING MACHINERY.

The first matter for consideration is, what class of seed or seeds are to be crushed?

This question and the correct solution will have great influence on working results.

It is in many cases evident that, the general practice in the past as been to first of all purchase the plant, and afterwards to decide n the seed that will be crushed. There are many kinds of seeds, and ften they cannot be treated with the best result in the same kind of nachines.

If a merchant, or capitalist, decides to purchase a second-hand oil nill, which has often occurred, he should first consider, will the nachinery crush the particular seeds he is interested in, and is the lant in a sound condition, or what will it cost to make it so.

Many mistakes are made in this way by purchasing plant second nand, which is low in price, and when there are totalled up the cost of repairs, replacements, loss of time by breakdown, and inefficiency n not being capable to give a good extraction, it would be found that the plant was exceeding dear instead of the anticipated bargain.

It is invariably cheaper to purchase new machinery direct from well-known makers, rather than to speculate in the second-hand variety.

Erection of machinery.

This is a matter of the utmost importance, and is one of the cases where it is folly to grudge what may appear to be a heavy expenditure.

Many good machines have been spoiled by faulty erection, and more money is wasted through bad erection and spacing of plant than is spent on having a first class engineer to supervise the work of assembling and erecting the plant.

Care of machinery.

This is equally important, since upon the satisfactory working of the machinery depends whether or not a maximum output is obtained, and whether at the end of a year's work machines have to be wholly replaced, or only minor renewals made.

It is particularly noticeable in these provinces, as compared with mills in Bombay and Ahmedabad, that there is a great deal of carelessness in looking after machinery, and, if proprietors were alive

to the fact, by being able to recognize it, they could lengthen the life of their plant by many years.

Importance of seed cleaning.

This is a matter which appears to have escaped the notice of mill owners, or they are content to consider it of no importance.

Seed as delivered to the oil mills contains quantities of sand, dirt and other foreign material varying from 3 to 10 per cent.

In some mills the seed is emptied from sacks and allowed to discharge upon a screen of wire gauze which is almost in a vertical position, the idea being that this will eliminate the sand. In reality it separates only a very small quantity of it, and much of it being in a finely divided state, blows about and again settles on the seed, and also often on the machinery.

In short, this treatment is useless, and is pure waste of time, money and labour.

During the past year at the suggestion of this department two mills have installed rotary seed cleaning machines, and a third mill is contemplating a similar improvement.

The advantages to be gained by thoroughly freeing the seed from these foreign non-oily substances are many .—

(1) If the 3 per cent. of dirt and sand is removed from the seed, it permits a mill to crush, at least 3 per cent. more seed, in other words, the capacity of the mill is increased by 3 per cent.

(2) In addition to this extra capacity for seed crushing, it increases the output of oil, and prevents that 3 per cent. of sand from becoming coated with a film of oil, which is not pressed off when the meal is subjected to pressure.

(3) The removal of the sand prevents it coming in contact with such wearing parts of machinery as disintegrator screens, disintegrator blades, the rollers of seed rolls, and the brasses of expensive bearings as are on these machines

(4) Such plant as disintegrators, and rolls which at present are often forced to overwork, are relieved of 3 per cent. of their work.

(5) In factories where Oil expellors are at work, their upkeep and renewal account will be enormously reduced by thorough cleaning of seed.

Upon two occasions it was observed that in cleaning mahua seed, by means of the rotary seed cleaning machine, the following results were obtained :—

(*a*) In one mill five maunds of dirt were removed in one and half hours, work.

(*b*) In one mill it was found that by the proper cleaning of seed the yield of oil was increased between 3 and 4 per cent.

THE REMOVAL OF HUSK FROM CASTOR SEED.

Although many mills, equipped with hand power screw presses, have been in the habit of partially removing the husk, there are still many establishments which crush the seed with the husk on.

Castor seed has a husk which varies in quantity from 26 to 34 per cent. of the weight of the seed. By the removal of this husk, which contains no oil, the capacity of a mill crushing castor seed can be increased by 26 to 34 per cent.

Further than this, there is a large saving on coal, wages and wear and tear on plant, the hard husk of the seed is known to cause great wear on such things as roller machines.

By decorticating castor seed, a great improvement can be effected in the colour of the oil produced, which enables a better price of one to three rupees more per maund, to be obtained.

DISINTEGRATORS.

These useful machines are subjected to bad usage. The seed passing through them, usually containing from 3 to 10 per cent. of sand, rapidly wears away the square edges of the beaters, and soon cuts through the bars of the screen. Seed should be cleaned before it enters the disintegrators (see " Importance of Seed Cleaning ").

A disintegrator is useful in the oil seed industry for breaking up such seeds as linseed, mahua, til, poppy, and rape before they are passed on to the rolls.

In some mills, seed is being passed through a disintegrator, and straight on to the seed kettle without any rolling process.

This is a bad practice, as only a portion of the oil cells have been broken and it is not possible, with treatment such as this, to obtain the best results from the Pressure plant, an unnecessary amount of oil being left in the cake, which means loss of profit.

The screens should be varied in mesh according to nature of the material being treated, which is a point not realised by everyone.

The mesh can be smaller with seeds deficient in oil, which will make the subsequent rolling process more efficacious.

Noticeable defects in the erection of these machines are :—

1. Bad design of the brickwork foundation resulting in constant choking up of the outlet for meal.
2. Bad materials used in making the foundations, resulting in heavy vibration, and if not attended to, will result in the machine breaking away from the holding down bolts, which may cause loss of life to mill hands, or break other machines.

The best possible materials should be used for these foundations, and they should, if possible, be strengthened with metal tie rods.

In every case where a disintegrator is in use, it should be driven from the shafting by means of a clutch pulley, since there is no room for fitting fast and loose pulleys, and consequently, no quick and simple method of stopping the machine in case of necessity. The usual practice in these Provinces is, to slow down the whole mill, and throw off the belt by means of a piece of timber, or iron, pressed against the edge of the belt. The process is repeated on re-starting the machine. Examination of the belts in local oil mills will conclusively prove that they are subjected to rough treatment, and, that under such conditions the life of a belt is one half of what it would be, if treated

in a reasonable way. Disintegrators can often be observed to be in motion, when the machine is not in use, this consumes several horse-power per hour.

Seed Rolls.

In the whole of the mills, there are at present only two which possess rolls of suitable size for the rest of the plant.

This is unrecognized by proprietors of oil mills, with the result that it is impossible to properly extract the oil.

Invariably the seed is passed through the rolls at too great a speed, so that the rolling is ineffectual, and the oil cells are often not broken, or only partially broken.

The amount of oil lost to the Province in this way each year must be to the value of thousands of rupees. Much power is consumed by old fashioned rolls in comparison with the modern type fitted with roller bearings.

So far there is only one instance in the Province of a mill being equipped with the type of rolls known as Reduction Rolls. These machines are in common use in Europe. Whole seed can be passed straight into these rolls without any preliminary breaking. The reason that this is possible is on account of the top three rolls being groved, usually the top roll is coarsely groved, and in the second and third rolls the groving is finer and closer together, the bottom pair being smooth. The meal coming from properly designed reduction rolls is actually finer than that which has first passed through a disintegrator and then through Anglo-American rolls. By using reduction rolls, the use of a disintegrator can be dispensed with, thereby effecting a saving of horsepower which may be 15 to 30 H. P., according to the size of the mill.

Seed Kettles.

There is a general tendency for engineering firms to supply kettles of insufficient size.

It is a common fault, not only in the United Provinces, but also in other parts of India. This fault results either in the hydraulic

presses being kept idle, while the meal is being cooked, or that half cooked meal is passed to the presses, which again results in loss of oil. It is possible to find many cases of wholly uncooked meal, being added to a kettle, while meal is still being withdrawn for cake moulding. Insufficient attention is given to admitting the correct amount of moisture to the meal.

Pressure guage and thermometers, for ascertaining the temperature of the steam, and checking the correct temperature of the meal while in the kettle, are conspicuous by their almost complete absence, or, where they have at one time been fitted, they are broken or damaged as to be useless.

This carelessness causes loss of money, loss of oil, and discolouration of the oil by overheating, and, if the cake was intended for shipment overseas, a further loss would be incurred.

The type of kettle in use in these Provinces is usually of the most inexpensive kind, and usually the most inefficient.

Types to be avoided are those where, no means are provided for lubrication of the bottom bearing of the stirrer, which sooner or later finish their career, by the stirrer shaft eating its way through the steam jacketted bottom.

A good type kettle should have a steam jacket on the bottom, and sides, and the stirrer shaft should pass through the bottom and rest upon a proper bearing which is provided with suitable lubrication.

In most mills there is an absence of any attempt to cover the kettle sides, and bottom, with any non-conducting material. By neglect of this, steam is wasted and the meal takes longer to cook, than is necessary.

In a few cases attempts have been made at insulation, but the material used is both insufficient in quantity and quality.

The stirring gear of seed kettles should be fitted with fast and loose pulleys so that the stirrer may be stopped in an emergency, or when not required.

Wrought iron kettles are preferable to those made of cast iron. The difference in cost is not so great, when the calculation of freights are considered, in conjunction with the price. Kettles should be fitted with a steam trap, and care should be taken to see that the trap is in working order.

Cake Moulding Machines.

These are of two types, driven either by steam or by hydraulic power. Those in use in the Province are mostly of the former type.

There can generally be noticed that insufficient attention is given to the packing of the steam gland, and much steam is wasted. In certain cases the placing of the moulding machine is bad, being arranged so that the operator has to work left handed, which tends to tire the operator and slow up the work of loading the presses.

It is not uncommon to find that the strickling box, or receptacle for conveying meal from the kettle to the moulding frame, is too large, or too small for the size of the moulding frame. This is wasteful, as it causes an amount of meal to be ejected from the moulding machine each time the ram rises, and around this machine, in most mills, there lies an excessive quantity of meal, which gets carried about on the feet of the workers to all parts of the mill, it necessitates a man to be continually sweeping up and returning it to the kettle, where it gets over cooked and probably receives an excess of moisture which, in its turn causes squirting of the meal, out of the presses.

Care should also be taken to have the strickling plate in direct line, and level to the top of the moulding frame so that, when the strickling box is drawn out and replaced, there is no jerking, thereby spilling further quantities of meal on the press room floor.

The position of the moulding machine should be such that the end, where the moulded cake is withdrawn, is facing the front of the presses. A small matter, as this appears to be, will prove to be a considerable saving in labour to the man loading the presses and it will speed up the loading of a press.

This end of the moulding machine should not exceed eight feet in distance, from the front of the presses for the largest cakes, and can be reduced to six feet in the case of smaller cakes.

Anglo-American Presses.

These presses are driven by means of an hydraulic pump, working direct on the presses, or they may be worked by means of a hydraulic pump working through hydraulic accumulators.

In the Province, the system is, to use an hydraulic pump only. While being a cheaper method in respect to capital outlay, it cannot be considered cheap over a long period of working, since the time saved by accumulators, in raising the ram to the point where oil commences to be extracted, would rapidly repay the extra cost, the time saved can, in many cases, be taken as 2 minutes per press, which in itself represents a considerable item and may mean several extra presses per diem.

Until the present year, there has been the bad mistake made, of erecting Anglo-American presses within two feet of a wall, it is difficult to imagine the reason for this error, as it completely prevents the process of unloading a press from the back. In actual working it causes the operators, loading and unloading, to be consistently in each other's way, and may be calculated to loose half a minute, or more, per press, besides causing congestion in having several men working on the one side of the press.

In the loading of hydraulic presses, care should be taken to pack in the cakes as evenly as possible, so that the iron press plates all lie level, if care is not taken in this matter, the plates have uneven strain put upon them, press bags or cloths are burst and torn, and much creeping and squirting out of the meal takes place, and not infrequently press plates are broken, as can be seen by the numbers of cracked and broken press plates lying in mill compounds.

In some mills, through using the wrong kind of press cloths (see press cloths) and through uneven packing in of the moulded cakes, it is often found impossible to fit in the last cake. One instance occurs

where the presses are continually in use with, one cake less than could be placed in the press, thus the capacity of this mill is reduced over 6 per cent.

Cases often occur that it becomes necessary to take out the hydraulic ram, when this happens, or when a ram is being fitted back into its cylinder, the utmost care is required to prevent the ram becoming dented or even scratched.

When the necessary care has not been used, a ram damaged by a dent or scratch, will result in hundreds of ram leathers being destroyed annually, to say nothing of many working hours being lost by time taken in dismantling the press, to replace the leathers.

There are, in most mills, plenty of chances of speeding up and increasing output by proper handling of presses, and labour, and there should be plenty of openings for intelligent men as mill mangers, if owners would only recognise what is being wasted and lost by inefficiency.

Every hydraulic press should have fitted to it a pressure guage, these are usually supplied included with the plant as an essential part.

Observance made in many mills show that gauges have at some time been fitted, but when they have been broken, or get out of order, no one troubles about having them repaired or refitted. Without a pressure guage it is impossible to get uniform results, often the pressing operation is rushed, and not completed in consequence. In cases where the relief valve has become out of order, and no pressure gauge is in use, there is grave danger of straining the whole hydraulic plant.

Better results might everywhere be obtained, if more care was taken in speeding up the loading and unloading of presses, by bringing the ram up rapidly to the point where oil starts to flow, and then at once to put on the high pressure pump, and not to hasten unduly, this high pressure portion of the pressing. The oil should not be allowed to come out too quickly, as the tendency is for it to carry with it quantities of meal, and also to rapidly break up the press cloths, if this part of the operation is forced and hurried.

In cases where there are several presses, it is quite common to find one or two of the presses being kept under pressure for a considerable time with the raised edges of the plates touching, in which cases much of the pressure is wasted.

To remedy this defect, the cakes should be moulded slightly thicker, so that the whole pressure is exerted over the area of the cakes and not divided over the larger area, which includes the whole surface of the plates.

Faulty Erection of Anglo-American Presses.

Here is shown a battery of four presses erected so as to cause the owner a heavy loss. It will be observed that the presses are close against a wall so that it is only possible to effect the operations of loading and unloading the press from the front side (see page 22).

A battery of badly erected Anglo-American press.

On the floor in front of the presses is a sloping platform which is one foot in height, this is put so that the operator loading the press can reach the top plate to load and unload the cake. This absurdity results in the two men loading the four presses, having to climb up 14,400 feet per week carrying a seven seer weight, all totally unnecessary, during the whole of this time occupied in the operation of climbing, the oil mill proprietor is paying wages for this wasted period. Seeing that the oil trade in other countries is worked upon an efficient basis,

and that profits are extremely small and only obtainable by efficient management and control, the author of this book is often inclined to wonder how long the proprietors of oil mills in India will be allowed to squander the wealth which is in their trade, if only they would endeavour to obtain it, and build up substantial reserves they would be ready for fighting competition when it comes. The time is not far distant when competition will be as severe in India as it is in other countries.

Press Cloths.

Sufficient attention is not given to selection of the most suitable type of press cloths, whether this is due to ignorance of what is required, or to the fact of the miller buying the cloth which the press cloth makers like to offer him, is not known, but the facts show that much more money is squandered on unsuitable press cloths, than should be the case.

This material is usually sold by weight, which may account for the anxiety of the press cloth maker to get the oil miller to use a quite unnecessarily heavy class of cloth.

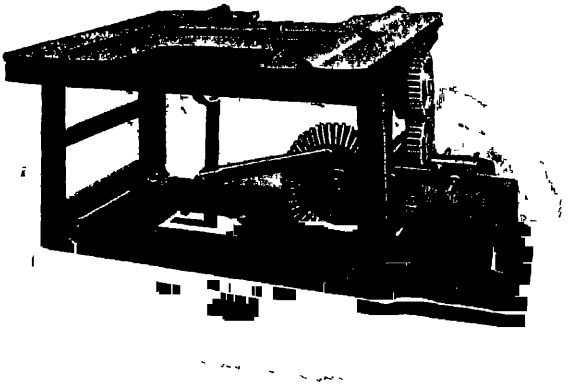
It is worth while making a study of press cloths. In many instances it will be found that they are occupying 15 to 20 per cent. of the whole pressing capacity of a mill.

It is necessary to get a strong and not too thick press cloth, to get the fullest benefit of the press, by filling it with oil seeds instead of press cloth.

By such common sense methods, it is possible to materially increase the present output of almost every mill in the Province which uses hydraulic presses, and at the same time the annual bill for press cloths can be very considerably reduced. The wastage of press cloths in the Province is abnormal, and, as these cost around Rs. 3 each, it would be possible for mills to save hundreds of rupees per annum in this item alone.

Cake Paring Machines.

The necessity for these machines in oil mills is occasioned by a considerable quantity of oil being left in the edges of the cakes. It is unfortunate to note that in many instances the cake paring machines are in a very bad state of repair, and some are out of work entirely.



Cake paring machine

In some mills there is no paring machine, the work being done by coolies which is uneconomical and a wasteful method of employing labour.

In a properly run mill these cake parings are returned to be ground in a disintegrator, or edge runner, and passed through rolls to the kettle for ultimate re-pressing.

The Grinding of Oil Cake.

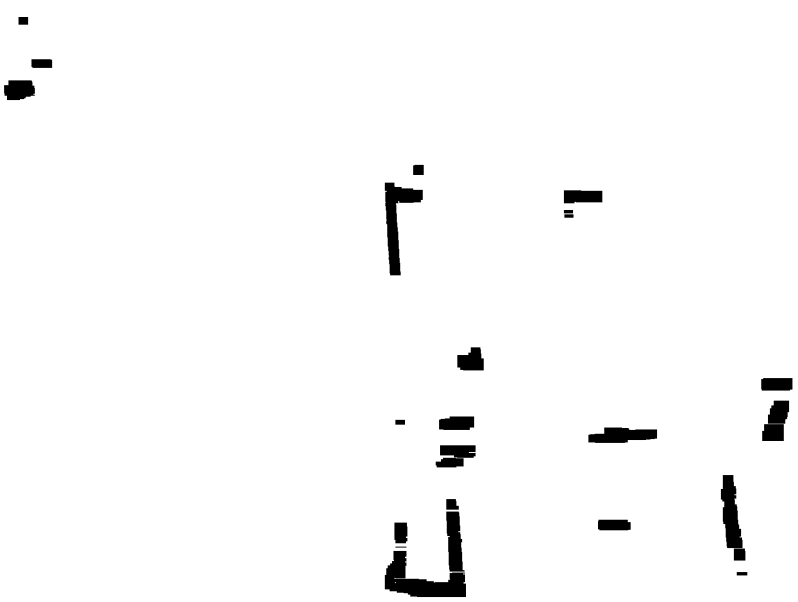
Most firms are in the habit of selling their oil cakes in the form of a cake. It would undoubtedly tend to popularise cake for manure purposes if it were sold in a finely ground state.

Oil mills have the machinery for this purpose, whilst the agriculturist has an arduous task in breaking up oil cake, which he can never grind as finely as would be the case, if the oil miller passed the cake through a disintegrator, or edge runner, before selling it. The more finely the meal is ground, the better it is as a plant food, which point is appreciated by the agriculturist.

Anderson Oil Expellors.

These machines should ultimately become much more popular with the oil industry of the Province than they are to-day. At present there are only three such machines in the Province, while, in the Bombay Presidency, there are a large number at work, as is also the case in Gujrat, where the oil crushing industry is thriving.

In this Province the wear on the cage, bars, worms, and cone, is



The Anderson oil expellor.

very much greater than it should be; if only owners of these machines would see that nothing but specially cleaned seeds is passed through them, they would be able to reduce the bill for repairs and replacement of worn parts, by almost 50 per cent.

To some people the cost of keeping these machines in running order appears heavy, but the fault lies almost entirely with themselves, and, if an efficient seed cleaning machine is installed, a marked reduction in upkeep costs will be recorded.

These oil expellors are remarkably efficient if correctly adjusted, and worked with intelligence. They have the advantage of giving a large output at reasonable power consumption, in which respect they are much more economical than—*ghanni*—or—*kollu*—mills.

This type of oil crushing plant is particularly well adapted for persons entering the industry with small capital, the space occupied by the plant is small, and there is no necessity for expensive foundation and buildings. The expellor requires 7 to 10 Horse Power to drive it according to the class of seeds being crushed.

It must be borne in mind that an expellor merely takes the place of hydraulic presses, pumps, and press cloths, and that there is required, in conjunction with it, such plant as disintegrators and rolls, for the preliminary breaking up of seeds and their oil cells.

Oil expellors are being successfully used in the Bombay Presidency for the crushing of such seeds as rape, linseed,—*til*,—copra, groundnuts, while it is stated that many firms in America are getting satisfactory results from these machines, when used for crushing castor seed.

The capacity of these machines may be taken to be as follows when used for crushing the seeds enumerated below—

Class for seed.	Output per hour.
Til	550 to 600 lbs.
Mustard	400 to 450 lbs.
Copra	800 to 900 lbs.
Groundnuts....	500 to 550 lbs.
Linseed	500 to 550 lbs.
Ramtilli	600 lbs.

Power Driven Ghanni or Kolhu Mills.

This ingenious invention is, as far as can be ascertained, one of the earliest machines used for oil extraction in India, and it still survives with sundry minor improvements. The types vary in different parts of the country.

In these Provinces they consist of a wooden body or mortar, strengthened by iron rings and driven from a shaft by means of a pinion working in a bevelled wheel fixed to the lower portion of the wooden mortar, above the wooden portion is a tapering bucket or seed container, the crushing is done by a heavy cast iron pestle which revolves by friction, being in contract with the lower portion of the wooden mortar.

There are various ways of considering these machines, and different

View inside a ghanni mill in 1926

opinions have been formed on them from time to time, but it must become obvious to everyone who cares to make the necessary calculation

that they are very costly machines, both in prime cost and in upkeep. It is not uncommon to find that the annual cost of repairs and renewals lies between 50 and 80 per cent. so that of all types of oil mill crushing machinery in use in the Province, the ghanni easily takes first place in extravagance.

In making a comparison between these machines and an Oil Expellor, the following observations under a separate heading will be of particular interest to many firms of seed crushers. The ghannis in use to-day are costing their owners vast sums per year, which unfortunately, they all fail to notice.

The construction of the machines is of the crudest possible kind, they are usually run in pairs so that often, two machines are thrown idle instead of one. They have no system of lubrication, beyond an occasional wipe with a mixture of mustard oil and meal on parts subjected to intense friction, subsequently this oil finds its way down the side of the machine to ultimately drop into the iron tray which receives the oil being extracted from the seed. As this overflow of so-called lubricating oil, which in reality, is a semi-drying oil, becomes black by charring and by admixture with particles of iron removed from the parts of the ghanni, as they grind against other iron parts, the discolouration of the oil must be quite considerable.

Even in new ghanni mills there is no effort at fitting, the bearings are merely very rough castings, which rapidly eat into the shafts, which run in them.

It only requires a glance around some of the compounds of ghanni mills, to get a very good idea of what an amount of labour and material is wasted, through the rough construction of all working parts

It is claimed by mills using the ghanni that, the oil produced in the ghanni is better than the oil produced by modern machinery. At present this claim is justified in some districts to the extent of ghanni mustard oil being sold at eight annas per maund more, than is obtained for the same oil produced in other plant. The sole reason for this

being that ghanni oil has the pungent mustard aroma, which is lacking in oil produced in other plant.

The power driven ghannis at present in use in the Provinces, are constructed entirely of cast iron with the exception of the wooden mortar in which the crushing takes place, this is usually constructed of tamarind or babul wood. The output from these machines may be taken to be 10 seers of seed per $1\frac{3}{4}$ hours.

Bullock Driven Ghannis.

These are of particular interest, since they have survived so far, in spite of competition from the power driven ghanni and modern plant. These mills are usually entirely constructed of wood with the exception of a small iron band fixed around the top edge of the mortar. The mortar measures 14 inches in diameter inside, tapering to 2 inches at the bottom, the depth of the mortar is approximately 12 inches.

The outside measurement is 17 inches diameter and 3 feet high, of which 18 inches is buried in the ground to keep the machine steady while it is being worked. There is a small hole in the bottom of the mortar, to allow extracted oil to escape, this is usually caught in a small earthenware pot, and transferred to another vessel, from time to time.

The marked difference in design between these and the power driven machines is that, in the bullock driven ghanni the pestle only revolves, while, in the power machine, both the pestle and mortar are in motion. The speed at which these machines revolve per minute are—

Power driven ghanni .... 14 to 16 revolutions per minute.
Bullock driven .... 5 to 7 ,, ,,

With the bullock driven machine the bullock walks is a circle varying from 8 to 12 feet in diameter.

The output from these small machines may be taken to be $3\frac{1}{4}$ seers of mustard seed crushed in 3 to $3\frac{1}{2}$ hours while the oil obtained is approximately $1\frac{1}{4}$ seers in 3 to $3\frac{1}{2}$ hours. The profit made on this work may be estimated at Rs. 1-2 per day.

The cost of this complete outfit, including the price of the bullock, may be assumed, on an average, to be Rs. 50 per ghanni.

The bill for annual repairs is approximately Rs. 20. In most parts of the Province there are a large number of these small mills. The owners are usually men with little or no capital, and they depend upon money-lenders for their finance to make purchases of seed. This money is borrowed on very high rates of interest resulting in the *Teli* having to work on an extremely small margin.

CHAPTER VII.

COMPARISON OF ONE OIL EXPELLOR AND 38 GHANNIS.

For the purpose of this comparison a number of ghannis must be taken so as to make the calculations upon similar output.

The estimate below gives the cost of these plants, the horse power consumed, and annual repairs, all based upon the cost of crushing mustard seed.

	One oil expellor.	38 Ghannis.
Output of mustard seed per 22 hours	149 maunds	120 maunds.
Horse-power consumed per hour with other machines such as rolls	25 H.-P.	38 H.-P.(Ghannis only.)
Cost of expellor	Rs. 6,000	Rs. 5,700
Cost of foundations	„ 50	„ 1,900
Cost of shafting belts	„ 100	„ 3,800
Output of oil per 22 hours	56 maunds	39·6 maunds.
Number of men required	2	4
Cost of set of rolls and foundations....	Rs. 5,000	
Cost of seed cleaning machine	„ 250	
Annual cost of repairs, rolls and seed cleaning machines	„ 200	
Annual repairs	„ 1,500	Rs. 2,850 to 4,560

From these figures it is interesting to calculate the result of 4 years' working.

	One Anderson expellor.	38 Ghannis.
	Rs.	Rs.
Cost of expellor	6,000	5,700
Repairs for 4 years	6,000	14,820
Cost of foundations	50	1,900

	One Anderson Expeller. Rs.	38 Ghannis. Rs.
Cost of shafting and belting	200	3,800
Cost of 1 set rolls	5,000	
Cost of seed cleaning machine	250	
Repairs for 4 years on rolls, and seed cleaning machine	800	
Wages at Rs. 20 per mensem	1,920 at Rs.14 p.m.	2,688
Total	20,220	28,908

OUTPUT OF OIL FOR 4 YEARS (300 DAYS PER YEAR).

		Rs
Oil expellor	67,200 mds. at Rs. 16	10,75,200
38 ghannis	47,520 „ „ „ 16-8	7,84,080

This shows a balance of Rs. 2,91,120 in favour of the expellor after giving the ghanni the higher price for the oil. On the figures for cost of plant and upkeep there is an additional balance of Rs. 8,688 in favour of the expellor which makes a net saving on the expellor of of Rs. 2,99,808. There is, in addition to this, a large saving on horse power consumed, the ghannis consuming 38 h. p. against the 25 h. p. of the expellor, rolls and seed cleaning machine.

The actual output in oil from the expellor plant, will be much greater than is stated, as the expellor will be crushing at least 3 per cent. more seed than the ghannis since it is crushing cleaned seed, this should increase the output of oil from the expellor by 1,500 maunds over the period taken.

There would also be a saving effected on rent or cost of buildings, the expellor plant would occupy about 25 per cent. of that taken by the ghannis.

CHAPTER VIII.

STEAM PIPES AND OIL PIPES.

Observation has shown that, there are few instances in the oil mills of the province, where any attention is given to the proper insulating of steam pipes.

The cost of covering steam pipes with suitable insulating material may, in the first instance, be considerable, but the saving that may be effected in coal consumption over a period of work, will more than compensate for the increased capital outlay. By proper insulation anything from 1 to 2 tons of coal could be saved each week by most mills.

The following figures will assist in making a calculation of the saving that can be made when steam pipes are properly insulated to prevent radiation, at the same time the losses that are being made by proprietors of oil mills in the province, can also be calculated.

Losses by horizontal bare iron steam pipe per lineal foot per hour as given in Mechanical Engineers Handbook by Kent.

AIR TEMPERATURE 70° F.

Size of pipe in inches diameter	Steam pressure	Loss of coal per hour.	Steam pressure.	Loss of coal per hour.
½″ diameter	80 lbs.	·022 lbs.	120 lbs.	·025 lbs.
¾″ ,,	80 ,,	·026 ,,	120 ,,	·030 ,,
1″ ,,	80 ,,	·032 ,,	120 ,,	·037 ,,
1½″ ,,	80 ,,	·044 ,,	120 ,,	·052 ,,
2″ ,,	80 ,,	·055 ,,	120 ,,	·063 ,,
3″ ,,	80 ,,	·077 ,,	120 ,,	·089 ,,
4″ ,,	80 ,,	·091 ,,	120 ,,	·114 ,,
5″ ,,	80 ,,	·118 ,,	120 ,,	·136 ,,
6″ ,,	80 ,,	·139 ,,	120 ,,	·162 ,,

In factories when economy is studied, the usual practice is to insulate pipes with asbestos fibre, and magnesia. This is usually put on the pipes to the following thicknesses :—

7/8 inches, 1½ inches and 2 inches.

A good insulating material should have good non-conducting properties, it should be fire-proof, impervious to moisture, uneffected by steam, non-corrosive.

A good plan is to cover the insulating material with strips of tarred canvas or old gunny bags so as to protect the insulation.

In the case of pipes meant for conveying oil, it is particularly necessary in mills where oils such as mahua and coconut are being crushed, to see that oil pipes are put up in such a way that there is a continuous fall in one direction, so that the pipe may empty itself when the pump has ceased work.

Carelessness in this matter often results in many hours of work being lost in the cold weather, as the oil solidifies in the pipes and it is not an infrequent occurrence to see numerous fires alight along the length of a pipe, in order to clear it, not only is this practice objectionable from the point of view of loss of time, but also in running considerable risk of setting fire to the entire mill. It is advisable to place oil pipes above the steam-pipe, wherever an opportunity occurs.

It is regretable to notice that in many mills, no attention is given to faulty joints, in both oil and steam-pipes. Steam may be seen blowing from bad joints for weeks on end, without any effort to save an obviously heavy loss of steam. Similarly oil is allowed to drip freely from pipes, and to soak into walls and floors of mills and godowns, in this matter, with more careful supervision, it might be possible to effect a very large annual saving in oil. Pipes of all kinds should, as far as possible, be carried overhead and not in recesses in the floor, which become traps for all kinds of material.

Losses through Oil tanks.

It is a common practice in the oil mills of this province to construct tanks, for receiving oil, in brickwork with a thin plaster of cement and sand. This is most undersirable on account of the action which the oil very soon has upon the cement, the cement becomes porous and oil soon finds its way through, resulting in the loss of much valuable oil. The cost of metal tanks would be very slightly more, in the first instance, but would effect considerable saving in the long run. No tank which is meant to contain oil, should ever be placed below ground-level, unless provision is made for inspection of the tank on all sides, otherwise it is not possible to rapidly observe leakage.

Tanks for oil should be made of iron, whether they are meant for storage or that in which the oil is clarified or refined.

Copper should never be used even though the copper is tinned, the tin very rapidly gets worn-off, and oil placed in tanks where a copper surface is exposed not only becomes discoloured, but is not fitted for human consumption, since copper salts become dissolved in the oil.

When tanks are used for receiving oil directly from the presses, or ghannis, the oil should be strained or filtered before entering the tank. In many mills it is not infrequently found that large quantities of meal in a state of decomposition is lying at the bottom of these tanks, which causes not only discolouration, but also the flavour of the oil is often spoiled.

Filter presses.

There is only one mill in the Province which has so far realized the importance of a filter press in an oil mill. The advantages of a filter press are many. The most important being that by passing oil through the filter press, directly it comes from the hydraulic presses, enables all the meal and most of mucilage being eliminated at once. This prevents the oil becoming discoloured by the meal, in various treatment which follow in clarification, and refining processes.

Another great advantage to be gained by the use of a filter press is that the meal which has been separated from the oil, is in a state suitable to be returned to the presses, or the oil may be still further removed by steaming the cakes in the filter press before it is opened for cleaning purposes.

When filter presses are used, care should be taken that the feed pump is not allowed to exceed the pressure that the filter press will stand, there should be a spring valve which releases any excess pressure, if this matter is not carefully watched, the filter cloths are subjected to unnecessary wear and tear.

Filter presses should be frequently opened and thoroughly cleaned with a wire brush, and clean filter cloths placed in the press.

Dirty filter cloths should be carefully scraped with a blunt instrument, and boiled in two or three successive baths of clean water, and should be perfectly dry before putting them back in the filter press.

An all important matter is, that filter presses for vegetable oils should be entirely made of iron, no brass, gun-metal, or copper parts should be permitted to come in contact with the oil.

Oil godowns.

Much improvement could be effected in the methods in use in oil godowns where oil is being filled into tins.

Invariably, considerable quantities of oil are spilled on the godown floors in this operation, much runs over the top and sides of the tin, and is carried, on the feet of the coolies, to all parts of the mill and mill compound. In some mills the ground outside the godown doors, is so saturated with oil that it has become almost like rubber, and, when heavy traffic passes over it, oil can be seen exuding from it.

The remedy for this is to place a small tank below the ground in a brick and cemented recess, immediately below the place where the oil is being filled into tins, over this tank should be placed an iron grating on which the tins are placed to be filled, any oil which is spilled, will then run into the tank instead of being spread over the floors and compound. A small outlay like this will pay for itself within one week.

CHAPTER IX.

Necessity for better selection of seed.

Throughout the province there is no mill which buys the seed to be crushed, upon the scientific lines existing in European oil mills.

In these modern establishments, every attention is paid to the selection of seed which is known to contain a high percentage of oil. Chemists are retained at these mills, continually making analyses of seed, and in ascertaining whether the correct percentage of oil is being extracted, by the mill machinery.

Without such information it is impossible to ascertain where losses are being made, or to calculate selling prices with any accuracy.

There is only one mill in these provinces which is able to make an accurate forecast of the result, which will be obtained from crushing any particular parcel of seed, which has been purchased, it is therefore, impossible to calculate correctly the profit likely to be made or to fix, with certainty of being correct, the selling price for forward contracts.

Seed is purchased from year to year, regardless of the percentage of oil it contains, or without any measurement of the moisture content. In the case of castor seed, no estimate is made of the amout of shell or husk enclosing the kernel, which may be as high as 34 per cent. of the total weight of the seed. The moisture in the seed varies considerably, being much less in the dry season than in the monsoon, these are factors which raise or lower the value of seed, and, if a mill is to be run successfully, it is necessary to have means of checking such varying factors.

For the purpose of defining these varying factors, numerous analyses of oil seeds from the province and elsewhere have been made at the Technological Institute, Cawnpore, which will clearly show oil-millers the risks they run in purchasing seed in this haphazard manner. Some of these seeds are being grown by the Department of Agriculture, United Provinces, with a view to finding seeds which are disease resisting, and, at the same time give a high yield of oil. From these tables of analyses may be seen possible reasons, for unaccountable losses, which are made by mills in the province, often a man in charge

of the crushing is blamed for getting a poor output of oil, in most cases the fault might be traced to the purchase of poor quality of seed. Buyers of seed, should recognize that, no matter how many years of experience they may have had of buying seed, it is quite impossible to guess by the appearance of the seed, its percentage of shell, oil, moisture, and free fatty acid content of the oil. The calculation can only be arrived at by proper analyses.

In examining the following tables it must be borne in mind that the figures are not meant to imply that all seeds from the districts mentioned contain a similar amount of oil and shell, variation will be caused by difference in quality of seed sown, cultivation, early or late varieties of seed, climate, soil, or that one part of a district is better watered than another.

In the table referring to castor seed it is easy to see that a mill crushing the varieties marked 11·I and 12·I would have a hopeless task to compete with a mill which was crushing the varieties marked 9·I, 10·I or 11·F which contain from 5·5 to 6·94 per cent. more oil.

The same applies in the case of sample no. 2-F which, when compared with sample no. 10·I, shows a deficiency in oil amounting to 11·32 per cent.

The following seeds were examined at the Government Technological Institute, Cawnpore, by Mr. M. N. Bose, M.A., who adds a note on his observances.

CASTOR SEED.

Reference no.	Percentage of shell on whole seeds	Percentage of moisture in kernels.	Percentage of oil in dry kernels.	District from where seed was obtained.
1.F	30·2	3·28	70·84	Madras.
2·F ...	33·47	3·28	67·70	Hyderabad (Deccan).
3·F ...	26·98	4·28	68·58	Madras.
4·F	23·82	3·95	68·74	Do.

Reference no.	Percentage of shell on whole seeds.	Percentage of moisture in kernels.	Percentage of oil in dry kernels.	District from where seed was obtained.
5·F ..	31·92	4·79	66·76	Madras.
6·F	24·52	4·52	68·11	Do.
7·F	23·96	4·46	69·23	Do.
8·F	31·04	4·17	68·01	Gujrat.
9·F	33·42	2·86	70·79	Do.
10·F	31·20	2·82	71·93	Kathiawar.
11·F	28·58	4·32	70·13	Do.
12·F	29·02	3·86	69·95	Madras.

Reference no.	Percentage of shell on whole seeds.	Percentage of moisture in whole seed.	Percentage of oil in whole dry seed.	District from where seed was obtained.
13.F	27·26	5·46	52·36	Chota Udepur.
14.F	28·26	5·52	50·10	Unknown.
15.F	28·36	5·31	52·23	Derol.
16.F	28·52	5·52	52·18	Unknown.
17.F	27·60	5·88	54·25	Siahpur.
18.F	28·84	6·04	53·03	Kharsalia.
19.F	28·64	6·46	52·69	Timber Road.
	28·96	6·44	49·91	Cawnpore.
1.I	30·42	2·64	51·36	Muttra.
2.I ..	24·72	3·28	47·52	Do.
3.I	33·00	2·55	47·42	Bundelkhand.
4.I	31·42	2·99	45·25	Do.
5.I	27·58	2·57	53·79	Do.
6.I	30·16	2·86	47·25	Do.
7.I	31·10	2·95	47·68	Do.
8.I .. .	28·09	2·50	54·04	Do.
9.I	26·05	2·86	54·92	Do.
10.I	26·79	2·82	56·36	Do.
11.I	27·82	5·34	49·42	Orai, Jalaun.
12.I	27·52	5·05	48·06	Do.
13.I	30·5	5·52	47·36	Attarra, Banda.
14.I	27·24	5·5	48·26	Do.

Til or Sesame seed.

Reference no	Percentage of moisture.	Percentage of oil in dry seed.	District from where seed was obtained.
T.1.W.	5·68	55·60	Chittagong.
T.2.B.	6·04	42·24	Do.
T.3.W.	5·55	53·08	Burma.
T.4.B.	5·46	55·69	Do.
T.5.M.	6·24	55·82	Madras.
T.6.BR. ...	6·11	55·95	Do.
T.1.1.W.	7·72	54·49	Orai, U. P.
T.I.2.B.	7·38	54·14	Ditto.
T.I.3.W.	7·34	50·41	Atarra.
T.I.4.B.	7·38	47·22	Do.
T.7.M.	6·03	55·08	Bombay.
T.8.M.	5·38	49·64	Jabbalpur, C. P.
T.9.M.	7·21	53·79	Khandesh.
T.10.M.	7·98	48·08	Allahabad, U. P.
T.11.M.	6·89	51·53	Secunderabad.
T.12.M.	6·91	53·53	Jabbalpur, C. P.
T.13.W.	7·17	51·63	Gujrat.
T.14.M.	7·21	50·47	Katni.
T.15.M.	7·72	53·06	Banda, U. P.
T.16.	6·81	55·62	Hyderabad (Deccan)
T.17.	7·79	54·28	Bhopal State.
T.17.	7·75	54·35	Bhopal State.
T.18.	7·59	53·16	Ditto.
T.19.B. ...	6·31	49·52	Bankok (Siam).

Note.—W.—White variety.
B.—Black variety.
M.—Mixed variety
BR.—Brown variety.

Mahua seed.

Reference no.	Percentage of moisture.	Percentage of oil in dry seed.	District from where seed was obtained	Date.
X	5·89	51·50	Fatehpur....	27th October, 1923.
X.1	6·07	51·12	Do.	Ditto.
X.2	4·52	54·33	Binki	November, 1923.
X.3	6·29	52·66	Benares	Ditto.
X.4	5·86	53·94	Gorakhpur	Ditto.
X.5	5·90	46·99	Azamgarh	Ditto.
X.6	4·41	51·95	Delhi ...	December, 1923.
X.7	5.88	51·51	Tebul Ghosi	Ditto.
X.8	6·39	47·31	Cawnpore....	February, 9124.

Rape seed.

Reference no.	Variety or colour.	Percentage of moisture.	Percentage of oil in dry seed.	District from where seed was obtained.
1	Yellow sarson	9.24	42.82	Unknown.
2	Lahi	9.38	41.72	Do.
3	Mixed black and yellow	5.12	44.58	Cawnpore.
4	Yellow sarson	9.23	50.34	Fatehgarh.
6	Ditto	4.83	49.75	Cawnpore.
7	Juncea	6.26	44.50	Do.
8	Mixed yellow and black	5.12	44.58	Do.
9	Brown small	7.88	32.16	Fyzabad.
10	Juncea brown small .. .	10.38	30.92	Cawnpore.
11	Mixed yellow and purple	6.13	43.57	Fyzabad.
12	Brown	5.16	44.16	Binki.
14	Yellow and brown	4.02	49.01	Basti.
15	Ditto	5.07	47.40	Do.

Reference no.	Variet or colour.	Percentage of moisture.	Percentage of oil in dry seed.	District from where seed was obtained.
16	Yellow	4.77	51.52	Shahjahahpur.
17	Duan yellowish brown	6.09	37.00	Do.
18	Black	6.74	37.39	Do.
19	Dark brown	5.99	42.59	Kiryat.
20	Ditto	5.85	48.45	Sikla.
21	Reddish brown	5.27	44.31	Dhenauli.
22	Yellow Brassica Alba	7·53	41.23	Saharanpur.
23	Yellow sarson	5.59	52.78	Azamgarh.
24	Small brown	6·56	27.42	Mirzapur.
25	Black	4.92	40.86	Ghazipur.
26	Dark brown	5.38	48.07	Azamgarh.
27	Rai brown	6.07	39.38	Ghazipur.
28	Black and brown mixed	4.68	45.72	Mirzapur.
1	Rai-red brown	5.12	47.97	Partabgarh.
X A	Black and brown	5.05	43.67	Baniapore.
X B	Small, black and brown	4.96	48·05	Haldwani.
X C	Red brown	4.21	45.40	Gorakhpore.
X D	Yellow and brown mixed	5.64	50.95	Basti.
X E	Small black	5.44	44.35	Do.
X F	Red brown	5.01	45.52	Ghazipur.
1 X E	Yellow	5.25	48.11	Gujrat.
1 X C	Do.	5.59	49.98	Mirzapur.

Linseed.

Reference no.	Colour.	Percentage of moisture in seed	Percentage of oil in the dry seed.	District from where the seed was obtained.
B. L. 1	Brown	8.25	45.06	Bhopal State.
B. L. 2	White	8.15	50.25	Ditto.
P.Y.W.	Brown	7.47	40.81	Bihar.

Reference no.	Colour.	Percentage of moisture in seed.	Percentage of oil in the dry seed.	District from where the seed was obtained.
P. Y. 12	Brown	7.66	38.35	Bihar.
P. Y. 19	Do.	6.97	41.51	Do.
4	Do. ...	7.24	44.29	Attarra.
5	Do.	7.45	44.89	Jaitpur-Hamirpur
6	Do.	7.19	45.27	Rath-Hamirpur.
7	Do.	7.36	41.54	Gonda.
8	Do.	7.49	40.7	Basti.
9	Do.	8.27	35.13	English Flax seed, Cawnpore.
10	Do.	10.34	25.60	Red Flower, Cawnpore.
11	Do.	7.77	44.04	Cawnpore.
12	Do.	8.15	43.49	Kurrahi-Hamirpur.
13	Do.	6.6	42.65	Fyzabad.
15	Do.	6.65	44.64	Partabgarh.
16	Do.	5.57	44.51	South of Binki
17	Do.	5.92	44.41	Ghazipur.
18	Do.	6.15	43.08	Kunda.
19	Do.	8.78	41.75	Morocco.
20	Do.	8.53	41.78	Levant.
21	Do.	6.17	45.12	Allahabad.
22	Do.	5.99	40.86	C. P.
23	Do.	6.04	45.72	Jhansi.
24	Do.	5.99	43.53	Basti.
25	Do.	6.63	44.59	Ghazipur.
26	Do.	3.74	42.89	Basti.
27	Do.	5.72	44.11	Rohilkhand.
28	Do.	6.67	44.46	Basti.
Z. X.	Do.	6.67	42.69	Deoria Town.
A	Do.	5.92	44.14	Partabgarh.
Z. A.	Do.	6.20	44.39	Baramadpur-Azamgarh.
Z. B.	Do.	5.68	42.01	Basti.
X	Do.	5.74	43.45	Mirzapur.

Note on the examination of the oil seeds listed on pages 40—45 by Mr. M. N. Bose, M.A.

In order to estimate the amount of oil in a sample of seed, the following method was adopted.

From 50 to 100 seeds according to size were carefully decorticated, the kernels being separated from the husk, in the case of castor and groundnuts.

The kernels and shells were weighed, the dry matter in the kernels was determined, and later the dry matter was also determined in the shells.

The kernels of castor seed were extracted with chloroform, 10 grams of kernels being taken, and extracted in a Soxhlet apparatus for three hours, after this time the ground kernels were again re-ground, and the extraction continued, for a further two hours.

The solvent was then evaporated off and recovered, until the oil was free from smell of solvent, by means of a Bunsen burner and low flame. The oil was then placed in an air oven for 3 hours at 105° C. to 108° C. and the weight taken. The percentage of oil was calculated on the dry matter of the kernels. The percentage of oil on the whole dry seeds would have been slightly higher, had the moisture in the shells been taken into consideration.

An examination of the figures for castor seed, show that the percentage of oil in the dry kernels varies from 65·98 to 77·02 and in the dry seed from 45·25 to 56·36.

Conclusive results could not be obtained because of, the mixed character of the samples, but if an effort were made in the province to isolate the pure races, the percentage of oil may go even higher. The conclusion arrived at is that, a high yield of oil in the seed does not depend on their size, but upon their compactness within the shell, without any hollow space between the two halves of the kernels. The percentage of shell has, of course, a great bearing upon the oil content of the whole seed.

GINGELLY OR *til* SEED.

About 23 samples of *til* seed were examined, these were composed of black, white and mixtures of both. In this case whole seed were taken, the solvent used being dry ether.

The figures in the table show that the oil percentage varies from 42·24 to 55·95, a difference of 13·71 per cent.

No definite conclusion was arrived at so far as defining whether black, or white seed, gave a higher yield. Sometimes black seed gave better results than white, and *vice versa.*

It is interesting to note the comparison made by Lewkowitsch in Oil Fats and Waxes, Volume II, between Indian seed, and African seed, which when analysed by Sprinkmeyer and Wagner showed Indian seed to yield 49·76 per cent. oil, while African is stated to yield 54·14 per cent.

In the seeds examined at the Technological Institute, Cawnpore, most of the samples of Indian seed contained more than 50 per cent. of oil. Where seed is deficient in oil, it may be due to bad storage, as many of the samples received, were attacked by weevils.

LINSEED.

Forty samples were extracted by means of petroleum ether. The percentage of oil varied from 35·15 to 50·12 a difference of 14·97 per cent. In cases where the yield appeared unusual, the extraction was repeated and checked. It is unfortunate that the white seed offers difficulties to the agriculturist as do many other varieties, in so far as they are often susceptable to disease, and give a low yield of seed per acre.

The fact that the white seed appears to give such a high yield of oil, should attract the serious attention of the agriculturist to produce a disease-free white seed, giving a good yield per acre.

Rape seed.

Thirty-five samples of various colours were extracted with petroleum ether. The oil content of the seed varied from 27·42 to 52·78 per cent., a difference of 25·36 per cent.

With but one exception the yellow seed gave the highest yield of oil. The smallest seeds gave the poorest results.

Brown seed of medium size gave better results than bold seed of the same colour.

Approximately 90 per cent., of the samples examined were mixture of yellow, brown, and black seed. Consequently, it was difficult to judge their quality from colour only. It seems customary to grow the seed from mixed varieties, which makes it a difficult matter for oil mills to make their purchases on a satisfactory basis.

It would be of the greatest value to the oil crushing industry if, it were possible to purchase in bulk pure varieties of seed, and thus enable the mills to either crush pure varieties, or to make their own mixtures if desired.

M. N. BOSE.

Government Technological Institute, Cawnpore.

CHAPTER X.

Plant used in modern oil mills.

In the following pages there will be found illustrations and descriptions of types of machinery used in modern oil mills. It may be noted that but few of these machines are existent in oil mills of the United Provinces or of India. Where they have been installed, they have usually been badly erected, and are generally badly looked after.

In modern oil mills, there are a number of other types of machinery, which it has not been possible to show illustrated in this book, such as a variation in the type of decorticator for different classes of seed, magnetic separators of different type, automatic weighing machines for weighing and registering the quantity of seed weighed, meters for recording the quantity of oil passed from presses to the refinery, and in the same way from the refinery to storage tanks. Such plant is perhaps not yet required in India, where there is such vast room for economies, which are obvious to anyone with moderate intelligence.

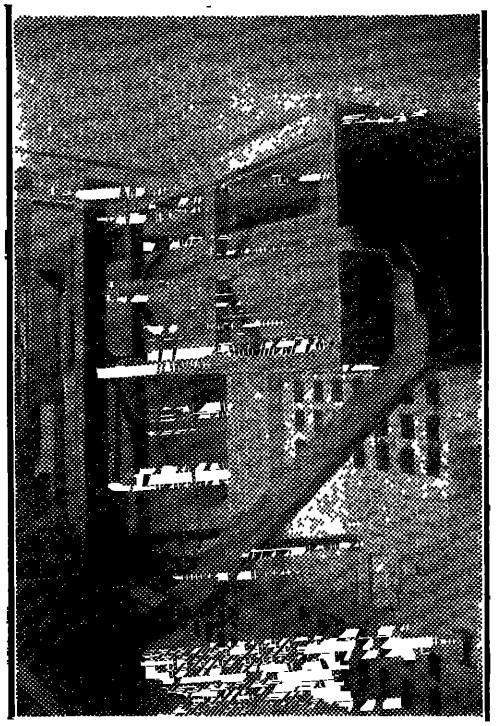
Seed cleaning machines.

These machines are possibly the most important of all auxilliary plant for oilseed crushers in India.

Seed as it arrives at the mills is usually very dirty and may contain from 3 to 15 per cent. of dirt, sand, straw, or other impurities.

In order to get the maximum quantity of oil from the seed this dirt must be removed, since if it is allowed to be crushed with the seed, the whole of this dirt and sand becomes coated with a thin film of oil and it is impossible to recover it by pressure.

Apart from this heavy loss of oil, the dirt, if not removed from the seed is going to occupy anything from 3 to 15 per cent. of the capacity of the machinery, and the labour in the mill has to be increased to handle this unnecessary rubbish. The type of machine shown in the accompanying illustration is one of two which have been made locally on the advice given by the Department of Oil Technology, Government Technological Institute, Cawnpore.



Rotary Seed Cleaning Machine.

This particular machine has removed 5 maunds of dirt from mahua seed in 1½ hours.

The machine is capable of cleaning 800 maunds of seed per day. The machine is of simple design and the cost of it is, but a small item compared with the results which can be obtained.

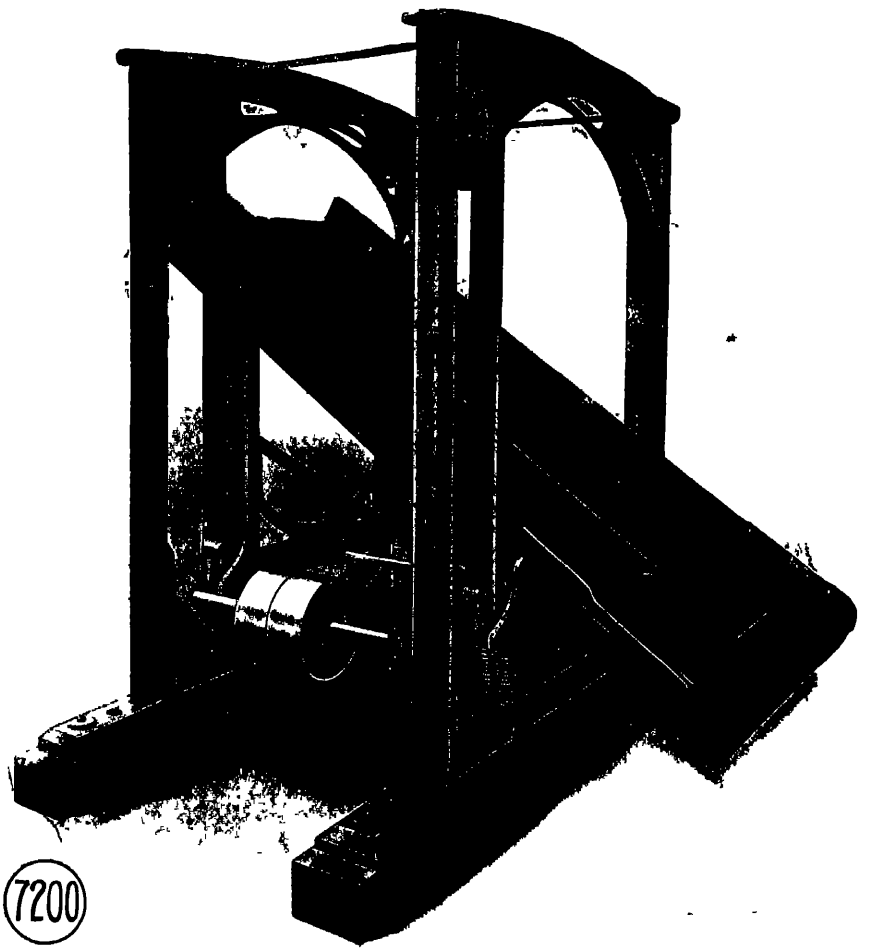
One mill having installed a similar machine, found that they were able to obtain between 3 and 5 per cent., more oil than was obtained before this machine was introduced.

When the time comes, that, all the larger oil mills of the province use these machines it will be found that they are increasing their profit by between 10 and 12 lakhs of rupees annually. It will be observed that this cleaning machine is enclosed in a dust-proof

box, so that the dust is prevented from spreading over the factory. The picture shows the front cover removed for cleaning purposes.

Electro-Magnetic Separators.

These machines are installed in almost every oil-mill in Europe and America.



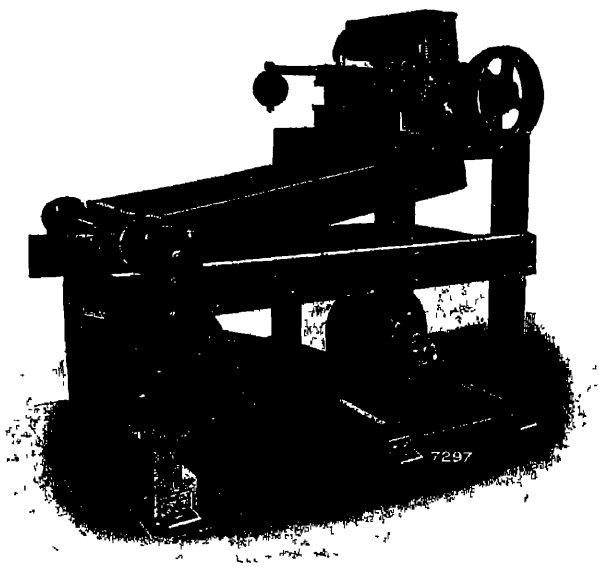
Electro-Magnetic Separator.

Their use is to separate from the seed any pieces of metal which is commonly found mixed in with seed, such as nails, bolts, nuts, hoop iron, etc., which if permitted to pass into the machinery would certainly cause very serious damage. The whole of the seed entering the mills is passed over the sloping shute on which are a number of flat bar magnets, which hold any metal which passes to them. At the lower end of the shute is a device known as the collapsible bridge. In the event of the electric current failing, which works the magnets, this bridge collapses and thus prevents any iron pieces which may have been on the magnets, from passing on to the mill machinery.

Decorticating Machines.

These machines are of various types according to the class of seed that is being treated.

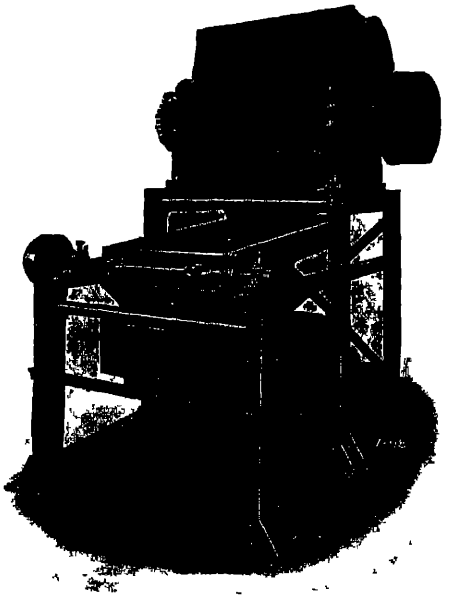
The machine shown here is particularly suited for removing the hard shell from castor seed, so that the kernel which is that part of the seed which contains the oil is practically clean and free from shell and ready for pressing. The shell which has been removed contains no oil, and as this shell represents approximately 30 per cent. of the total weight of the seed, its removal before crushing will increase the pressing capacity of the mill by a similar amount, at the same time there is 30 per cent. of unnecessary material removed which does not require to be handled further, thereby effecting a large saving in labour.



A seed-decorticating machine.

The machine illustrated may have either a wooden or steel framework in which are fitted a pair of horizontal smooth or grooved rollers, the pressure of which can be adjusted by means of levers and sliding weights. The rollers are set so as to merely crack the shells.

On passing between the rollers the kernels and shell fall on to a shaking tray which gradually passes both to a hopper, this feeds a wooden pipe through which a blower is forcing a current of air, the husk is blown out of the open end of the tube, while the kernels being heavier are passed out of a separate opening in bottom of the wooden tube.

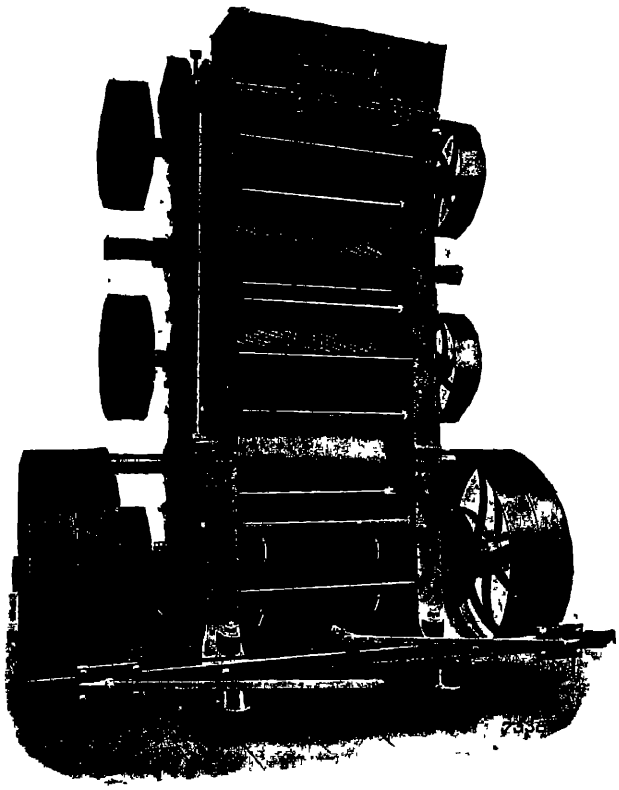


Another view of a decorticating machine.

Seed-Crushing Rolls.

These machines are usually constructed with either four or five rolls. The rollers are made from chilled cast-iron which material, being much harder than ordinary cast-iron, lasts considerably longer. Each roller is carefully ground dead true so that the seed gets equal pressure at all parts of the roller. These rolls are usually fitted with powerful springs situated on the top of both side frames, so that the pressure exerted by the rolls may be adjusted to suit different classes of seed. In some cases the rolls are grooved which assists in rapidly reducing seed to the form of meal.

The illustration shows that the bottom roll is driven from both ends, which is a great improvement; it may be observed also that each driving pulley has a loose pulley so that, the machine can be stopped without interfering with other plant. For a slight extra cost the bottom roll may be fitted with roller bearings which effect a saving in power required to drive the machine, representing 30 per cent.

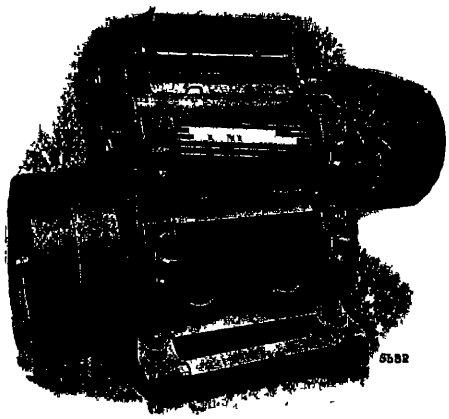


Seed-crushing Rolls.

The rollers vary in size from 8 inches diameter and 8 inches long to 24 inches diameter and 48 inches long. The small rolls cannot be recommended, and small mills would be well advised not to instal seed-crushing rolls with the rollers of smaller size than 16 inches diameter by 30 inches long. These seed-crushing rolls are essential to every oil mill, and it is folly for oil mill proprietors to attempt crushing such seeds as mahua, til mustard, linseed, poppy seed or cotton seed without them.

Reduction Rolls.

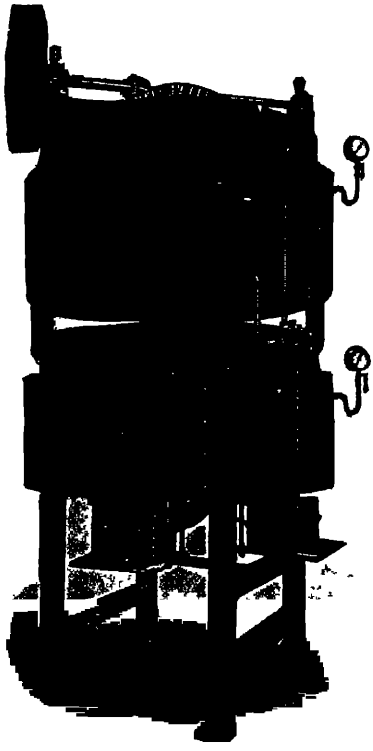
These machines are in regular use in European oil mills. They are usually made with one, two or three pairs of horizontal rollers. They are made with grooved rollers, and also with plain rollers depending upon what class of seed is to be treated. They are particularly useful for use with seeds such as copra, castor, and groundnuts which will not bear heavy rolling, until freed from some of their high oil content. In many mills such seeds are first passed through reduction rolls, which merely reduce the size of the seed without actually milling it. The seed is then pressed, the cake afterwards is broken up and milled through the 5 high Anglo-American rolls and pressed a second time. These reduction rolls could be used to advantage in India for the preliminary reduction of such seeds as copra and mahua.



Reduction Rolls.

Meal Heating and Cooking Kettle.

In the illustration is shown the double type of kettle which is almost non-existent in India.



The modern double seed cooking kettle.

The meal from the roller machines is fed to the top kettle only, where it is cooked or partially cooked, the meal is then allowed to come into the lower kettle and is further heated, it is then withdrawn to the moulding machines. In this way only properly cooked meal is taken to be pressed, and it is impossible for cold meal to be fed to the press.

The type shown allows two moulding machines to be fed at the same time. The kettles have steam jackets, both at the sides and bottom, and it will be seen that both kettles are fitted with pressure gauges.

This type of kettle is made to feed up to four moulding machines at one time, they are also constructed for feeding 3 cage presses.

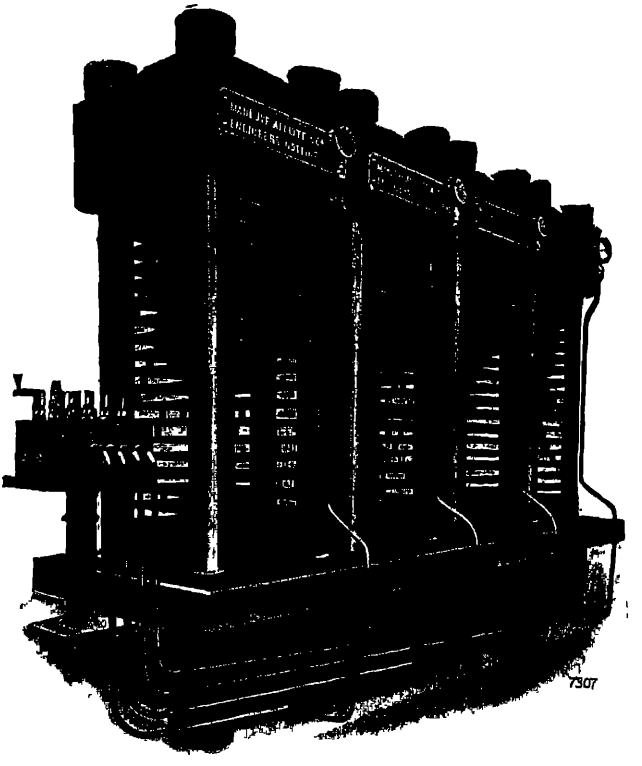
In the illustration below is a view of one of the few double kettles which are in India.

A double seed-cooking kettle erected in an Indian Oil Mill.

There may be seen fixed to the kettle 2 steam pressure gauges and a thermometer—the latter has been broken some three years and has not yet been replaced.

ANGLO-AMERICAN HYDRAULIC OIL PRESS.

The accompanying illustration shows a battery of 4 Anglo-American Presses. Each press is separate and each has its own tray to catch the expressed oil. The type shown with 15 plates is particularly suitable for India. Presses made to press more than 16 cakes are unsuited to this country on account of the difficulty which a man of short stature has in placing cakes between the topmost plates.



A set of four Anglo-American Press.

The presses should be erected in such a way that the floor level should be in a line with the bottom of the oil tray. If attention is given to this point in the erection of presses, it will be effectual in saving much time when the plant is at work. The presses vary considerably in size, and in power, the working pressures varying from 2 to 3 tons per square inch calculated upon the ram area. The rams vary in size from 12 inches diameter to 18½ inches. Firms ordering new plant would be well advised to pur-

chase presses giving high pressures on the cakes, instead of the class of press which is so common throughout India, which usually have only 2 tons working pressure. The size of plates is another question of importance in India, where the physique of the coolies, who are to load and unload the presses, must be considered, the maximum sized plate should not exceed 28 inches long by a width of 12 inches with presses for 16 cakes.

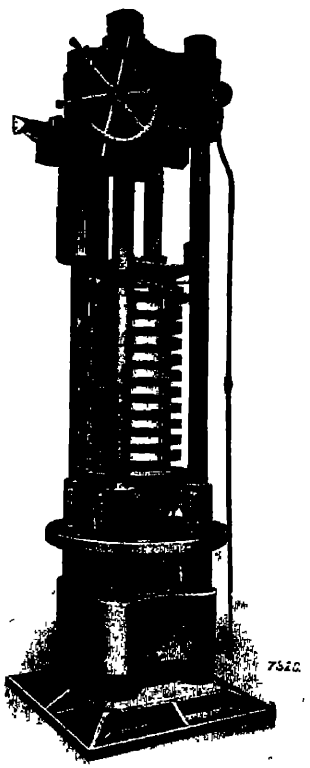
With presses made for pressing 22 cakes, the size of plate should be reduced to 28 inches long by 10 inches wide, so that the labour can handle them easily and quickly. The type of plate which can be recommended is that with bevelled edges, and without flanges. This plate avoids much damage and the cutting of the press cloths, and the plates themselves are less liable to damage than those with flanged edges. In this picture may be seen a battery of 4 presses as they have been erected in a mill of this province.

Four Hydraulic Presses showing how they have been badly erected.

On the top of the right hand press may be seen the one pressure gauge for 4 presses instead of one for each.

The presses have been erected in such a way that as they are within 18 inches of a wall, and it is impossible to unload them from the back, which causes confusion in the loading and unloading of the presses, to say nothing of the loss of time. It is particularly interesting to note the sloping platform at the front of the presses which is required to allow the man loading the press to reach up to the top plates of the presses.

It evidently never occurred to the engineer who erected these presses, that it would have saved the mill proprietor thousands of rupees, had he erected the presses so that the top plates were within reach from the floor level.



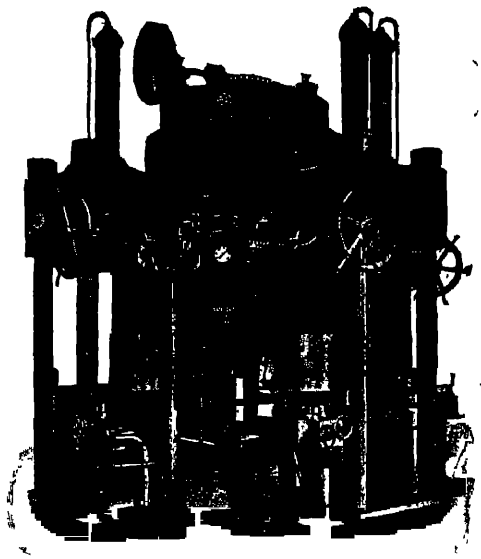
The Hydraulic Cage Press.

Hydraulic Cage Presses.

This type of press has become very popular in Europe during the past 15 years. The cost of the presses is considerably higher than that of the Anglo-American type. They vary considerably in size and capacity, the output varying from 280 lbs. of seed per hour to 1,120 lbs.

These presses give considerably higher pressure on the material being pressed, than is obtained by the Anglo-American Press. The modern cage press is made to give pressures up to 4 tons per square inch on the cake. Such presses usually have a ram of 18 inches diameter. The illustration shows a cage press erected, but the working floor is not shown. The floor will come at about the level of the fourth ring from top of the cage. A press of this type giving 4 tons pressure will weigh between 26 and 28

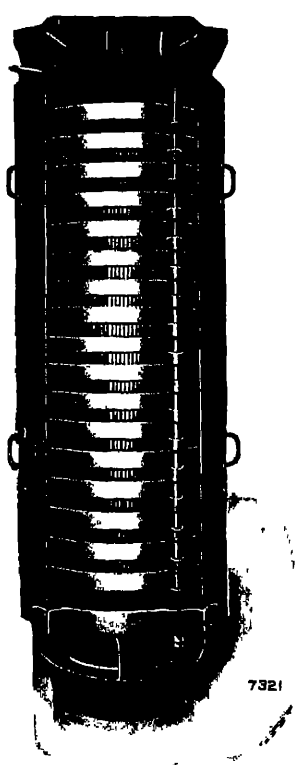
tons. The height of the press when fitted with kettle and elevators for seed is approximately 45 feet. The second illustration depicts a battery of three cage presses arranged around a double kettle, each complete with its own set of hydraulic control valves. These particular presses are shown fitted with hydraulic loading or packing rams, so that during the operation of loading meal into the press, the meal may be occasionally compressed so as to make certain that, the press is fully loaded, and it also enables the plates and cakes to be packed into the cage in an uniform and level manner. Both illustrations show the moving head, which is removed and replaced in position, when unloading or pressing, by means of the wheel shown which, when turned by hand puts the moving head in the desired position.



Three Cage Presses.

This Battery of three presses can be operated by four men and it is possible to press 40 to 45 maunds of seed per hour with this equipment.

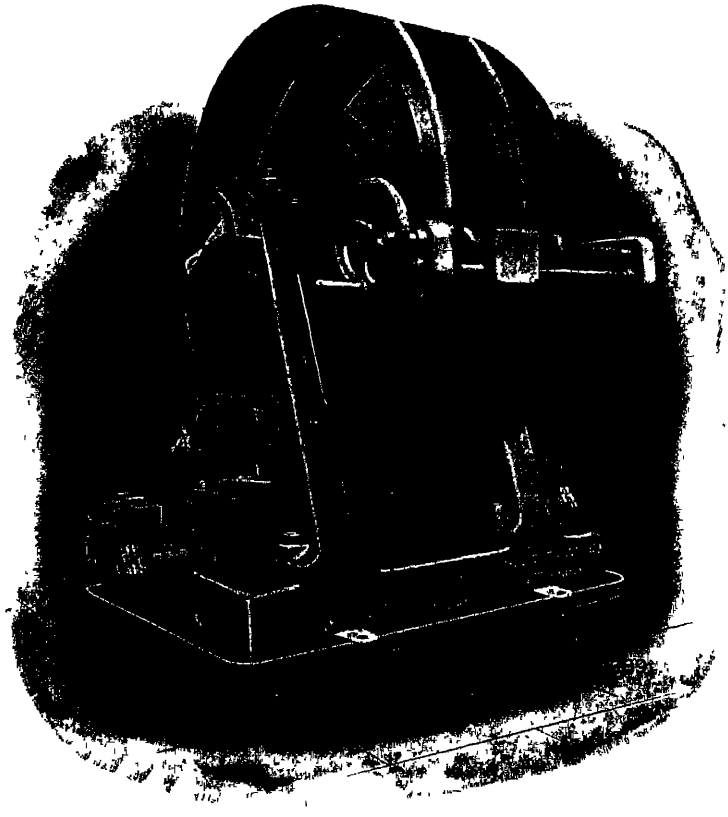
The third illustration is of the cage of the press. This cage is built up of a number of vertical steel bars, held together by means of 17 weldless steel rings, which have been shrunk on. These rings are again held in position by distance pieces, placed between each. The vertical steel bars are of special section which enables the meal to be retained within the press, while the oil escapes through the space between the bars which varies from 3-1000 parts of an inch to 1-32 of an inch.



The Press Cage.

Hydraulic Pumps.

In India there are many mills equipped with a very bad type of hydraulic pump, in which the valves are most inaccessibly placed. Often, it is necessary to dismantle the pump in order to get at the valves. This causes great loss of time especially as it is necessary to grind in the valves at least once per week. The pump shown has a fast-and-loose pulley, and is fitted with the necessary gear for moving the belt. This pump has four rams of which one high pressure and one low pressure ram are situated on each side. The pumps are constructed so that any one of the rams may be put out of action when it is necessary to change a ram leather.



An Hydraulic Press pump.

Hand Screw Press.

In the accompanying picture is seen the hand screw press. This is a very slow and laborious method of pressing oilseeds, and such material as meal from settling tanks.

The Hand Screw Press.

The press has two columns which connect the two ends of the press, between which are some 80 to 100 plates, between these the seed is placed in cloths or pieces of gunny-bag. Below the press is placed a trough, or tray, which catches the oil. Usually these presses are erected in pairs about 2 feet apart, and a quantity of smouldering oilcake, or charcoal is kept between, which serves to heat the presses and liquefy the oil so as to increase the flow of oil. At each end of the press is a screw ram which is tightened and alternatively loosened by means of a wheel attached to it.

The threads on these screws are of different pitch, which enable the press to be more rapidly closed by means of, the screw with the steeper pitch. The other screw is utilized when it becomes difficult to turn that with the steep pitch, and it is with this screw that the high pressure is applied. The two wheels are fitted with a number of square recesses into which a long pole is inserted, by means of this pole a big leverage is obtained.

In the illustration may be seen the pole on which there is a small platform; this is used when it becomes too difficult to turn the wheel. The man operating the press climbs the pole and places his feet on the platform and then throws his weight back so as to pull down the lever. This is particularly hard work for the operator, and is perhaps the hardest form of work in which labour is engaged in the whole of the oil industry. These operators are usually paid by a system of contract; they are supplied with seed and are paid at a contracted rate per press.

This type of press is usually confined to the crushing of castor seed, and to the recovery of oil from meal which has precipitated, in oil-settling tanks. They are also used in the United Provinces for crushing such seeds as mahua and neem.

The extraction of oil by these presses, if not too much hurried, gives quite efficient results; castor cakes which have been taken from these presses and analysed have shown that they contain as low as 6 per cent. of oil. The reason of this is probably due to the size of the cakes being very thin as compared with the cakes of Anglo-American presses. The capacity of these presses varies considerably according to the number of plates and cakes that they hold, and upon whether or not the operator is giving the seed the maximum pressure. In the contract system of payment, the operator must return an agreed quantity of oil from seed supplied to him, so that this enables a certain standard of efficiency and output to be maintained. A press of this type containing hundred plates $12'' \times 5''$ will crush approximately $2\frac{1}{2}$ maunds of seed per press. Each press will be loaded about four or six times per day which enables 10 to 15 maunds of seed to be crushed in a day of ten hours. These presses cost approximately Rs. 600 each.

The largest mill in the province containing this type of press is owned by the East Indian Railway, where, there are some 30 of these presses, which crush annually over 130,000 maunds of seed.

Power-driven Screw Press.

This is the invention of Mr. O. N. Deveraux, a consulting engineer of Calcutta. The invention is covered by patents.

The inventor claims to be able to work three presses with a 3 H. P. engine, and to increase the output from an ordinary hand screw press, 50 per cent. by means of his power attachment.

Arrangements have been made for the manufacture of this machine with the Saran Engineering Co., Ltd., of which the managing agents are Messrs. Begg Sutherland & Co., Ltd., Cawnpore.

If the inventor's claims are correct the invention should be of great use to the many oil mills all over India, which are equipped with the ordinary hand screw press.

The Deveraux Power Driver Screw Press

Bullock-Power Ghannis.

The accompanying photograph was taken in Cawnpore, of what

A bullock driver Ghanni Mill, one of a number which can still be found in all towns and villages of Northern India in 1926.

is possibly one of the earliest type of oil mill that has existed. It seems at first sight a very remarkable fact that such mills can still exist and the owner make a profit from it, in the face of competition from power-driven ghanni mills, and modern hydraulic presses. When the matter is studied it does not appear so wonderful. The building in which this photograph was taken was composed of brick and mud walls,

with a roof of split bamboo tied in places where they crossed, with grass rope, these supported an amount of grass and palm leaves which completed the roof.

The equipment of the mill was practically identical with that described on page 31 under the heading "Bullock-driven ghannis." Total cost of the bullock and ghanni is Rs. 50, the annual upkeep of the ghanni is Rs. 20. The bullock is fed on grass which the Teli and his family collect, and occasionally a small amount of the oilcake produced is fed to the animal. The cost of feeding the bullock is annas 8 per day.

Working nine hours per day the mill crushes between 9 and 10 seers of mustard seed from which some 3 to 3½ seers of oil and 6 to 6½ seers of oilcake are obtained, the profit obtained varies with the market conditions, but it appears to be between 12 annas and Re. 1-2 per day. The Teli makes no reckoning in this calculation of his own labour or that of his family. It will be noticed that the bullock is blindfolded; this is done so that the animal may walk continuously in a circle which is 12 feet in diameter without becoming giddy.

The mill is a most interesting and ingenious contrivance, made in the roughest possible manner, and yet able to compete with mills crushing 200 to 300 maunds of seed per day.

Note the position of the small boy in charge of the mill; he is seated on a board attached to the wooden beam which acts as a lever for applying the pressure to the wooden pestle. He sits here for hours per day and revolves around the mortar as the bullock walks to drive the plant.

The chief reason that these mills are able to exist is probably due to the fact that they are low in prime cost and annual repairs, to no overhead charges, and no labour charges being in the reckoning, to a slightly better extraction of oil being obtained than that obtained, by

the power-driven ghanni, to the quality of the oil being considered better and more pungent in flavour than that obtained from the

The Village Ghani Mills of Southern India

power ghanni, to the very heavy cost of upkeep and general inefficiency of the large power-driven ghanni mills, and to the fetish existent all over India that good mustard oil cannot be produced in anything but the indigenous ghanni mill, where the oil is crushed in a wooden mortar. When the day arrives that a modern plant is erected and run by persons understanding the running of machinery and the technology of the oil industry, it will be the beginning of the end of this most interesting type of oil mill.

There is shown in the next picture, the type of oil mills in use in parts of Southern India. These are of larger capacity than those used in the United Provinces, and are frequently driven by means of a pair of bullocks.

Power-driven Ghanni Mill.

These machines are the most costly of all types of oil extracting machinery. If a new set are erected and worked it will be found that within a few weeks some part is worn out and needs replacement. The annual cost of repairs is between 30 and 50 per cent. per annum on the original cost.

It will be noticed that the machines are higher than the man in charge, hence it is necessary to build a brick platform for the operator to stand upon.

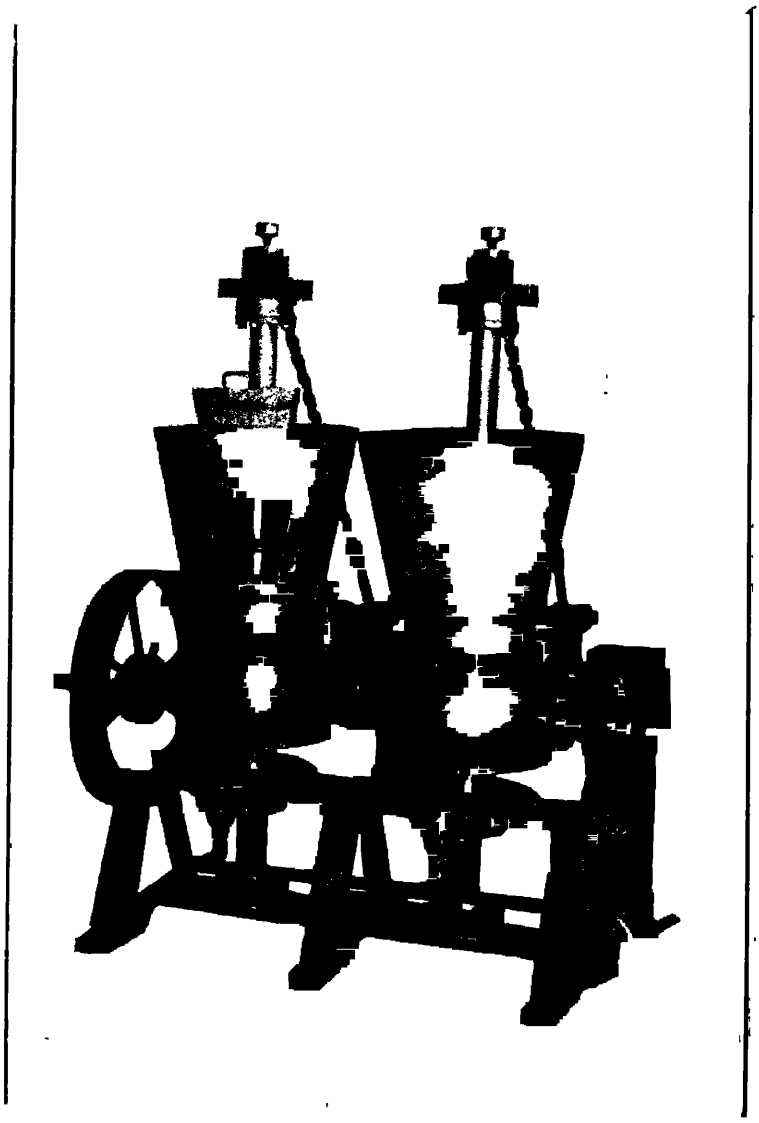
Look at the unnecessary amount of wood and metal used in construction. The reader will rapidly realize why these machines cost so much to purchase and keep in repair.

The ordinary ghanni mills—Note the height of mills as compared to the Teli.

There are shown a few of the iron rings which fit round the wooden body of the mortar, against which two pieces of cast iron, like chisels, are grinding during the whole time the machine is at work, some of these rings are broken through, others have holes worn in them. Also shown are two pestle caps, both of which have been cut through by wear of the pestle. Such things, and many other pieces of ghannis, can be seen in any ghanni oil mill compound in the province, lying about in heaps of 50 to 100 of each part, which represents a heavy loss to these provincial oil mills. Such wastage has been going on for at least 50 years if not more, which makes one marvel that any business can work profitably under such hopeless conditions.

There now appears to be an opportunity for local oil millers to avoid much of their losses if they will examine the merits of the Improved Lewis Ghannis shown below.

THE LEWIS IMPROVED GHANNI.



A pair of Lewis' Improved Ghanni Mills arranged with worm and wheel drive.

The Lewis Improved Ghanni Mill.

Its design is a vast improvement on the ordinary ghanni used throughout the province. Its capacity is 50 per cent. greater than the old machines and the power required to drive it is 25 per cent. less. These improvements alone make the machine infinitely superior to the old type.

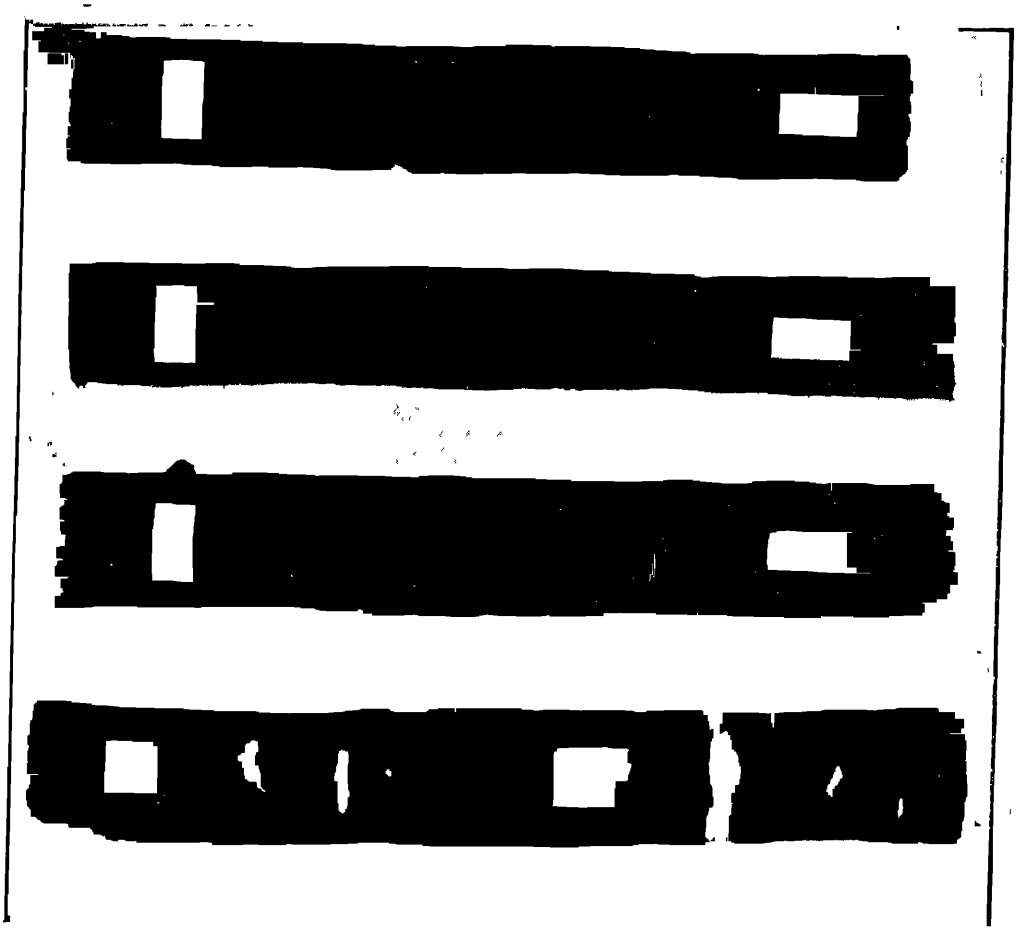
Into the design of the Lewis Ghanni have been introduced many new ideas for saving cost of working and cost of erection. Nine Lewis ghannis can be placed in the space occupied by three of the old machines.

The height of the machines is such that a man can fill and unload them from floor level and thus the necessity of the brick platform is done away with. The inventor is to be congratulated on his most successful effort to supply a long-felt want, and if oil millers wish to continue to use the ghanni mill they would be well advised to instal a few Lewis ghannis in preference to the type that they have formerly used.

Three Lewis' Ghanni Mills showing their reduced height as compared to the old type.

PRESS BAGS OR PRESS CLOTHS FOR ANGLO-AMERICAN PRESSES.

In this photograph are seen four cloths which have been experimented with by the Oil Department, Government Technological Institute, in conjunction with an oil mill in Cawnpore.



Anglo-American Press cloths showing different stages of wear.

Number 1 cloth and no. 4 cloth are the same cloth at different stages of wear. This cloth was made in England and cost Rs. 12

Number 1 picture shows the cloth after being used 545 times and was torn by the man unloading the press who used a hooked iron tool for pulling it from the press.

Number 4 picture shows the same cloth after being used over 2000 times.

Number 2 picture is of a cloth made in Cawnpore costing Rs. 6 and after using it 70 times it burst.

The tear can be seen at the left end of the cloth, this cloth could be used many more times.

Number 3 is an Indian-made cloth costing Rs. 3 and is by far the most expensive cloth of the three, it burst after being used 13 times.

By reducing these tests to figures of cost it is found that the English cloth is cheapest, although it costs most to purchase. Taking its life up to the time it was torn it was used 545 times for Rs. 12.

The Cawnpore cloth was used 70 times for Rs. 6. The Indian cloth was used 13 times for Rs. 3. Taking for example a hydraulic press holding 13 cakes it means that the cost of clothes when using the Indian cloth is Rs. 3 per press. Using Cawnpore cloths it is Re. 1-1 per press, whilst by using the expensive English cloth costing Rs. 12 each, which was torn by a careless workman after being used 545 times, the cost per press is only 4½ annas, but in actual working it will be found to come out in the direction of between 1 and 2 annas.

This is a calculation that seems so far to have escaped the notice of all the oil mill proprietors of this province, and in most other parts of India, and in this direction alone they are annually throwing away a large proportion of the profits that could be made.

By making the calculation upon the 26 hydraulic presses that are at present erected in the United Provinces it may be easily found that the money wasted through using the wrong cloth is costing the provincial mills lakhs of rupees per annum.

The first solvent extraction plant to be erected in the United Provinces at the Government Technological Institute, Cawnpore.

Solvent Extraction Plant.

The plant shown in the illustration is at present the only solvent extraction plant at present in this province. It is the property of Mr. E. L. Watson of Messrs. D. Waldie & Co., Ltd., Calcutta and Cawnpore, who has very generously lent it to the Department of Oil Technology at the Government Technological Institute, Cawnpore.

A somewhat similar plant has just been erected in Cawnpore and is under the charge of a man who has been trained in the above Department of Oil Technology, two views of this plant may be seen on the following pages.

In Europe and America these plants are to be found in many places, in India they have so far not proved a success, although there have been plants erected in Calcutta for some years.

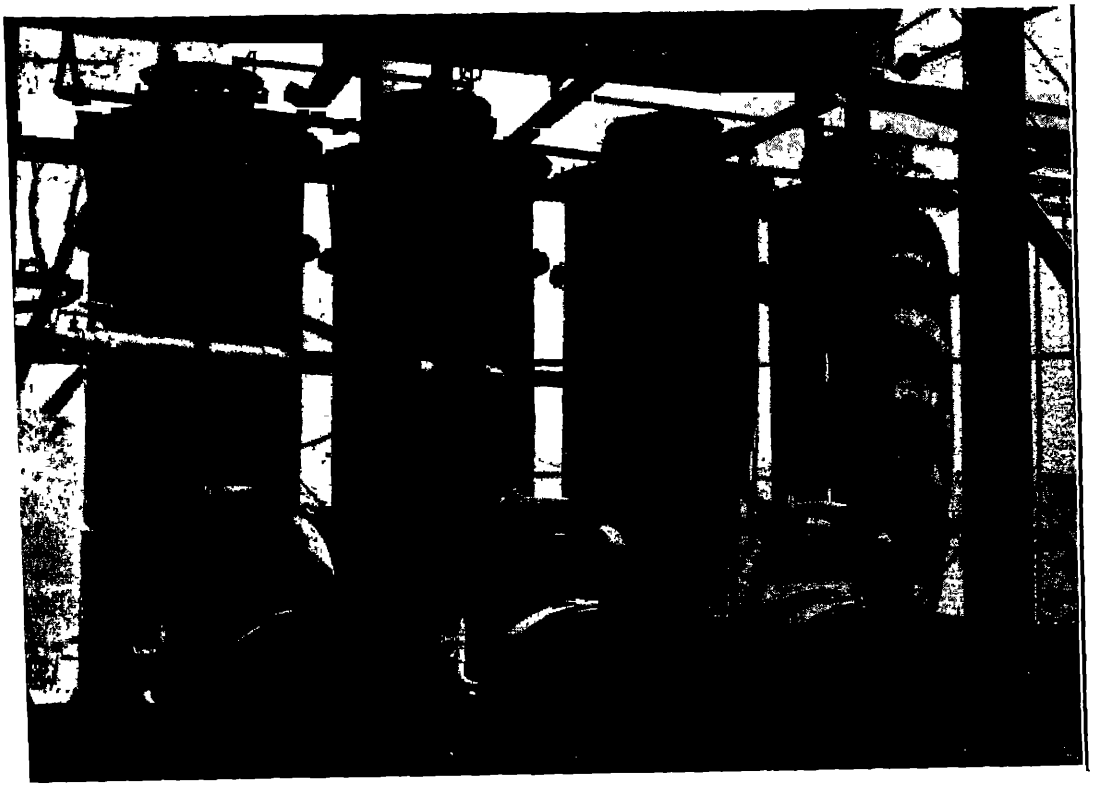
In theory, these are the ideal plant for oil extraction, but they must be constructed by high class engineers, and the design has much bearing upon whether the system can be worked profitably, or otherwise.

Such plant can only be worked successfully by skilled and painstaking persons. Much will also depend upon the temperature of the water-supply, and upon the question of suitable solvent being used for the material being treated.

Careless work will rapidly cause losses from which the proprietors of the plant will not recover. It is absolutely impossible for such plant to be worked by the ordinary mistri at present working in oil mills of the province.

In Europe such plants are used for the extraction of oil from, oil-seeds, oilcake, leather scrap from boot factories, wool waste, etc.

General view of the second solvent extraction plant erected in the United Provinces.



Four extractors and solvent recovery plant at Quitla Oil Mills, Cawnpore.

Steam Pipe

In the accompanying photograph there may be seen a good example of a steam pipe which for some years was not insulated.

An example of how money and coal is wasted by not having steam pipes properly insulated.

Before this pipe was covered by insulating material the loss by radiation was equal to the value of 7 tons of coal in 300 days works.

The losses which the owner suffered from this cause are thus very considerable, at the boiler there was a steam pressure of 120 lb., while at the other end of the pipe the pressure had fallen to 80 lb.

Until this fact was brought to the notice of the proprietor he had not considered the matter. In the picture the thicker of the two pipes is the steam pipe referred to, can be seen covered with insulating material.

The pipe which is not insulated is for conveying oil from one building to another. During the cold weather such oils as, Mahua and coconut, would solidify in the pipe and would cause a daily delay by having to heat the whole length of pipe by means of a blow lamp. In a case like this the pipe should have a considerable slope so that no oil can remain in the pipe.

A Primitive Hand Lever Press.

The accompanying illustration shows a very primitive type of oil press.

This press is the only one of the type known to the writer and is situated in Kankar state, Central Provinces. The press is composed of a branch of a tree which is inserted in a hole at the base of a tree in order to form a fulcrum. At a distance of about 2 feet from the tree, the branch is split and a stone is inserted in the split, this is then securely tied in position.

A very primitive oil press in the Central Provinces.

The prepared seed is placed on a larger stone which has a slight hollow on its upper side, ending in a small channel. When the seed is placed in this hollow the stone attached to the lever (branch) is lowered on the meal. At the right-hand side may be seen the man working the lever, which has attached to it two large stones to assist in the application of pressure.

In order to prepare the seed before pressing, it is broken up and put up in earthen pot. This pot has a small hole in the bottom in which is inserted a small piece of cloth. This pot is then placed over another pot which contains water, this in turn is placed over a fire which boils the water, the steam escaping up through the piece of cloth. Thus the seed is cooked and moistened before pressure in a similar way to the methods used in large modern mills. This heating and steaming of the seed occupies about an hour. There does not appear to be any information as to the origin of this very simple and yet primitive oil mill, all that is known is that, it is is an extremely old system which has been practiced in Kankar State for generation, and the stones in use have been handed down from the aborigines.

The press crushes 40 seers of seed in 10 hours working, yielding 10 seers or 25 percent of oil.

The seed usually crushed is mahua seed, the oil from the meal can be seen on the left side of the stone running down the channel and being caught in a small earthenware pan.

CHAPTER XI.

Conclusion.

To anyone who has carefully read the foregoing it must be clear that so far the oil mills not only of the United Provinces but also of India generally are still being conducted upon very primitive lines.

No improvement or at all events only very slight improvement can be made until the proprietors, managers, and managing agents, realize the necessity for mechanical knowledge. There are few oil mills in the country that employ a single man who could be said to have any idea of engineering.

There is undoubtedly a great scarcity of knowledge of engineering and mechanics amongst the class of man employed in the oil mills of India, as compared with other countries, and the result is that the machinery of the majority of mills is nothing more or less than a mass of scrap iron.

Occasionally one sees a good new machine being erected in a mill, and after a few months' work the machine is reduced to a state that makes its efficiency almost nil, and one can hear complaints that the machine was a bad one. No one appears to think it possible that, had a man with engineering experience been put in charge that the machine would still be as good as new. The Industry is at present being starved for want of engineers and mechanics who have really had training under competent instructors, that is, instructors who have had charge of machinery in well run establishments, such as are common throughout Europe and America, and not merely advanced coolies who have picked up a certāin amount of knowledge from seeing machinery at work under the most impossible and inefficient conditions. These remarks apply to many more industries in India besides oil seed crushing, and no manufacturing industry cān thrive in this country until there is a good supply of competent engineers and mecha-

nics who have received their training both in theory, and efficient factory practice.

When that time arrives, it is equally necessary that proprietors and managers of mills should be educated to the extent of knowing that, a man that knows his business can almost invariably command a higher scale of pay, and that the paying of a higher wage is a form of economy, which will show a handsome profit in the course of a year, when the bill for repairs and renewals comes to be examined, there will also be found a marked increase of the hours worked by the plant and in the output obtained.

Unless a very great change in methods used, comes over the oil industry of India during the next few years, there is but little doubt in the mind of the writer, that there will come a time in the near future when European and American oil millers will discover the possibilities of the oil trade in India, and will in due course establish modern and efficiently run mills in this country, with which the present Indian mills will be totally unable to compete. In this direction we already see a number of establishments emanating from Europe who have erected soap factories, oil boiling plants for the manufacture of high class boiled linseed oil, also a number of paint and varnish works.

These are merely the forerunners of larger things to come, and if India hopes to develop her own Industries with Indian capital and Indian management it must be done now. The Pioneers who start, and who set their factory on sound foundations, must surely survive. If, however, the start is made on unsound lines, with inefficient supervisors and workmen, and too little capital the business will on the other hand go the way of all others started under similar conditions.

The opportunities in India for the establishment of works, manufacturing the many products based upon oil seed crushing, are many, the country is full of the various raw materials required, and it only requires capital, plus sound common sense and a little determination

to develop India's manufacturing industries, included in the required commonsense is, the ability to recognize the necessity of employing as managers, supervisors, engineers and chemists, etc., only those who have received their education and experience in the right school. Those who have experience in theory alone are quite useless to assist in Industrial development, equally useless are those who have gained their expe rience in mills, factories, and workshops, under management unable to recognize the necessity of engineering, mechanical, or chemical knowledge.

There appears, in India, to a class of small capitalist most anxious to engage in Industry, but invariably his ideas are much beyond the available capital. These people usually have no knowledge of the industry in which they contemplate engaging their capital, and they appear to have no knowledge whatever of machinery, or engineering, consequently the failure which must inevitably result from such persons starting up in any industry, is partly the reason for the very slow development of manufacturing industries with modern methods.

Until our small capitalist is prepared to co-operate with several others, some with cash capital, and some with capital in the form of brains, knowledge, and determination to use it, there must be many failures and disappointments in India's industrial development.

For many years yet, there will be used in the oil industry the indigenous ghanni mill, both bullock-driven and the steam or electrically driven types. These cannot be scrapped at once for the simple reason that there is not capital available to replace them with other types of machine. Owners of such plant should carefully consider the question of the gradual replacement of these old ghannis by a type of machine that will give larger output and at the same time will require less power to drive, and less cost of repairs and renewals. In this respect the oil miller can, by using a little common sense, effect very considerable savings and increase his profit.

In mills equipped with hand screw presses the proprietors should carefully study the question of having their presses converted to power driven.

Where mills are equipped with the more modern plant such as expellors, Anglo-American presses, etc., the ability of the man in charge should be carefully studied, a really good man earning Rs. 200 to Rs. 300 per month is infinitely better value than one who is daily depreciating the machinery, and never getting the full output of the plant on a pay of Rs. 75 to Rs. 100, it is only because of his inefficiency that he is receiving pay on the lower scale. There is little doubt, judging by observation in a very large number of mills throughout India that, when the day arrives that there are numerous men available in this country who can be called "skilled" in their particular vocation, be it engineering, chemistry or even applying paint with a brush, that their scale of pay will be infinitely higher than it is to-day and at the same time the employer of labour will be in a far better position than he can ever be while the really skilled operator is non-existant in the necessary quantities.

List of machinery manufacturers making reliable plant used in the oil industry.

Machine.	Maker.	Indian agent.
Anglo-American Presses. Cage Presses .... Anglo-American Rolls. Reduction Rolls.... Hydraulic Pumps Accumulators .... Magnetic Separators. Meal Kettles .... Cake Breakers .... Cake Paring Machines. Oil Refining Plant	Manlove Alliot & Co., Bloomsgrove Works, Nottingham, England. Greenwood & Batley, Leeds, England.	Duncan Stratton & Co., Bombay.
Filter Presses....	S. H. Johnson & Co., Ltd., Carpenters Road, Stratford, London, E. 16. The Lillieshall Co., Ltd., Oakengates, Shropshire, England.	
Oil Expellors	Krupp Grusonwerke	P. R. Ridsdale, P. O. Box 103 Cawnpore.
	Anderson Expellor Co., New York, U. S. A.	Y. G. Pandit, Whiteaway Laidlaw Buildings, Hornby Road, Bombay.
	Frans. Smulders Utrecht, Holland.	Jessop & Co., Ltd., Calcutta.
Disintegrators	Carters, Dunstable, England Christy & Norris, Chelmsford, England.	Jessop & Co, Ltd., Calcutta. Marshall & Sons (India), Ltd., Calcutta.

Machine.	Maker	Indian agent.
Solvent Extraction Plant.	Ernest Scott & Co., Ltd., Briarfield Road, Silvertown, London, E. 16.	
Press Cloths	Jeremiah Ambler & Sons, Midland Mills, Bradford, England.	P. R. Ridsdale P. O. Box 103 Cawnpore.
	Cawnpore Woollen Mills, Cawnpore, United Provinces.	British India Corporation, Cawnpore.
Filter Press cloths	Elgin Mills Co., Ltd., Cawnpore.	Begg, Sutherland & Co., Ltd., Cawnpore.
Lewis Improved Ghanni.	T. R. Lewis, 77, Cantonments, Cawnpore.	
Hand Screw Presses.	Burn & Co., Calcutta.	
Steam Engines and Boilers.	Marshall & Sons, Ltd., Gainsborough, England.	Marshall & Sons (India), Ltd., Calcutta
	Ruston Hornsby, Ltd., Lincoln, England.	Greaves Cotton & Co., Bombay.
Varnish Pots	Aluminium Plant & Vessel Co., Ltd., Point Pleasant, Wandsworth, London, England.	
Oil Boiling Plant	Manlove, Alliott & Co., Ltd., Bloomsgrove Works, Nottingham, England.	
Soap Making Plant.	Ernest Scott & Co., Ltd., Briarfield Road, Silvertown, London, E.	
	Houchin Aiken Co., Inc., Hawthorne, New Jersy, U. S. A.	
	Weber and Seclander Maschinenfabrik, Helmstedt i Braunschweig, Germany.	

Machine.	Maker.	Indian agent
Decorticating Machinery.	Manlove Alliott & Co., Ltd., Nottingham, England.	
Decorticating Machinery for Groundnuts.	Great Eastern Engineering, 39—41, Apollo Street, Fort, Bombay.	Imperial Machine Co., 39—41, Apollo Street, Fort, Bombay.
Paint making Machinery.	Torrance & Sons, Ltd., Bitton, Bristols, England.	
	Follows & Bate, Ltd., Gorton, Manchester, England.	
Glycerine Plant	Fullerton, Hodgart & Barclay, Ltd., Paisley, Scotland.	
	Blair, Campbell & McLean, Ltd., Glasgow, Scotland.	
	Ernest Scott & Sons, Ltd., Briarfield Road, Silvertown, London, E.	
Elevators and Conveyors.	Manlove Alliott & Co., Ltd., Nottingham, England.	
Power Screw Presses.	Saran Engineering Co., Marhowrah, Behar.	Begg, Sutherland & Co., Ltd., Cawnpore.

1621